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EDITOR'S NOTE

The last issue of the Philippine Journal of Science, which was printed before the outbreak of the present war, is Volume 76, No. 2, October, 1941. Because of the present emergency and the circumstances attendant to it, no issues have been printed since then. Henceforth, however, it is intended to publish this Journal, as often as possible, with a view to making available the results of scientific studies and investigations conducted before the present emergency as well as those that are now being undertaken.

This number and the subsequent numbers will be a continuation of those of the last Volume, except for the months of issue, which will be those at the time of printing.

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THE PHILIPPINE
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DISTRIBUTION OF INSULINLIKE PRINCIPLE IN DIFFERENT PLANTS AND ITS THERAPEUTIC APPLICATION TO A FEW CASES OF DIABETES MELLITUS[1]

By FAUSTINO GARCIA

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THREE TEXT FIGURES

In the first report(1) it was shown that oral administration of the decoction of the old leaves of *Lagerstroemia speciosa*, known by the Tagalog name "banaba," with a dose equivalent to 2 grams per kilogram body weight, produced in normal rabbits starved for 24 hours a fall of blood sugar identical to the effect of subcutaneous injection of a moderate dose of insulin. In the second paper(2) the term insulinlike principle was proposed to designate the active substance, and its distribution and deterioration in different parts of *Lagerstroemia speciosa* were studied. It was shown that the old leaves and ripe fruits contain from 6 to 7.7 units of insulin per 100 cc of 20 per cent decoction, or equivalent to 20 grams of the crude preparations; that mature leaves, young leaves, and flowers have the activity ranging from 4.4 to 5.4 units per 100 cc of 20 per cent decoction; and that the wood does not contain the active principle,

[1] This paper constitutes the third report of a series of pharmacological studies on Philippine medicinal plants that might be used against diabetes mellitus. The greater part of the data presented was obtained while I was connected with the Department of Pharmacology of the College of Medicine, University of the Philippines. Read before the technical staff of the Bureau of Science at its seminar September 30, 1943.

while the bark and roots contain a very small amount. The rate of deterioration for every 20 grams of the dried parts of banaba per week is approximately 0.15 unit for fruits, 0.3 unit for old leaves, 0.58 unit for flowers, 0.6 unit for young leaves, and 0.9 unit for mature leaves.

In the present paper the study of the distribution of insulin-like principle in different plants was carried out, and decoctions made from two plants and a solution of white powder accidentally isolated were tested in cases of diabetes mellitus in the Philippine General Hospital.

METHOD

The method used in the experimental part is the same as that employed in the second report(2) which has been already published. The only difference is in the use of materials; that is, instead of using the different parts of banaba, different parts of different plants were employed. Generally the leaves were used, but in some cases other parts were tested. The experimental method consists in the use of rabbits once a week and the determination in duplicate of the initial or normal blood sugar of rabbits starved for 20 to 24 hours, by Hagedorn and Jensen's method, using 0.1 cc of blood; then administration of the preparation to be tested and again determination in duplicate of the blood sugar at intervals of one and one-half, three, and five hours. In calculating the equivalent units of insulin, the formula given in the New and Non-Official Remedies(3) for the standardization of insulin was applied. When fresh preparation was employed, the equivalent weight of it when dried was used in the calculation.

With reference to the clinical application, the patients were placed on constant calculated diet and the preparation was given three times a day by mouth in the form of decoction of the part found to contain the greatest amount of active principle or in the form of solution of the powder which was isolated accidentally. Blood sugar and urine sugar were determined at intervals.

RESULTS

Representative experimental results given as examples of the different trials of a part of the different plants are shown in Table 1. It may be seen in this table that *Syzygium cumini* (duhat), well known and popularly employed by the natives against diabetes mellitus, contains less amount of insulinlike principle than the old leaves or ripe fruits of *Lagerstroemia*

TABLE 1.—*Representative experimental results given as examples of the different trials of a part of different plants in the study of the distribution of insulinlike principle in different plants.*[4]

SYZYGIUM CUMINI (LINN.) SKEELS

Weight of rabbits.	Parts used.	Initial blood sugar.	Reduction of blood sugar after—			Unit per 100 cc of 20 per cent decoction.
			1½ hours.	3 hours.	5 hours.	
kg.	Mature leaves per kg. (d)—decoction:	*mg.*	*mg.*	*mg.*	*mg.*	
1.55	Fresh, 4 gm.=1.96 dried	127	—15	—18	—56	5.26
1.55	One week dried, 2 gm.	118	—43	—10	—2	4.36
1.55	Two weeks dried, 2 gm.	124	(a)	(a)	(a)	3.04
	Old bark—decoction:					
1.55	Newly taken, 4 gm.=1.68 dried	127	—9	—6	—34	3.54
1.55	One week dried, 2 gm.	111	—32	—2	—4	2.86
	Greenish-brown bark—decoction:					
1.55	Two weeks dried, 2 gm.	124	(b)	(b)	(b)	4.42
1.55	Three weeks dried, 2 gm.	121	—5	—28	—22	3.60
2.15	Greenish-brown bark, 1 week dried, 1.5 gm.—infusion	115	—9	—30	—11	4.74
2.00	Dried bark, fluid extract, 2 cc.	110	—24	—31	—25	6.14 (per 20 cc)
	Duhat seed, extract, 1 cc=24 gm. of dried seed:					
2.15	Extract of duhat seed, 1 cc.		—3			
2.25	Extract of duhat seed, 2 cc.		—9			
2.05	Extract of duhat seed, 3 cc.		—10			
2.20	Extract of duhat seed, 5 cc.		—11			

(c) Weak.

[a] Average—16. [b] Average—24. [d] All doses given are per kg.

TABLE 1.—*Representative experimental results given as examples of the different trials of a part of different plants in the study of the distribution of insulinlike principle in different plants.*[4]—Continued.

LAGERSTROEMIA SPECIOSA (LINN.) PERS.

Weight of rabbits.	Parts used.	Initial blood sugar	Reduction of blood sugar after—			Unit per 100 cc of 20 per cent decoction.
			1½ hours.	3 hours.	5 hours.	
kg.		*mg.*	*mg.*	*mg.*	*mg.*	
2.15	Old leaves, 1 week dried, 2 gm.	87	—30	—22	—13	7.70
1.75	Ripe fruits, 1 week dried, 2 gm.	84	—27	—19	—12	7.40
	CATHARANTHUS ROSEUS (C.) DON.					
2.20	Fresh leaves, 10 gm.=1.8 gm. dried	102	—17	—22	—10	5.72
2.15	Leaves, one week dried, 2 gm.	79	—21	+1	—13	4.84
2.30	Leaves, one month dried, 2 gm.	120	—18	—23	—29	4.60
	PITHECOLOBIUM DULCE (ROXB.) BENTH.					
1.50	Old bark, one week dried, 2 gm.	115	—8	—15	—23	3.92
1.50	Greenish-brown bark, one week dried, 2 gm.	122	—16	—27	—21	4.14
1.60	Mature leaves, one week dried, 2 gm.	120	—16	—24	—16	3.72
	IPOMOEA BATATAS LINN.					
1.7	Fresh tops, 10 gm.=1.9 gm. (pink)	98	—29	—23	—30	7.06
1.7	Fresh tops, 10.5 gm.=2 gm. (pink)	115	—31	—25	—39	6.76
1.6	Tops, one week dried, 2 gm. (pink)	103	—11	—22	—15	4.12
1.9	Fresh mature leaves, 10 gm.=1.2 gm.	88	+2	—3	+2	0.00

	IPOMOEA AQUATICA FORSK.					
1.65	Leaves and stems, white, 6 gm.=0.98 gm.	87	—4	—6	—5	3.70
1.55	Leaves and stems, pink, 6 gm.=0.98 gm.	88	—10	—16	0	6.12
	TAMARINDUS INDICA LINN.					
1.60	Fresh mature leaves, 6.44 gm.=2 gm. dried	82	—2	—14	—24	5.38
1.65	Fresh young leaves, 6.44 gm.=2 gm. dried	86	—3	—10	—20	3.38
1.90	Mature leaves, one week dried, 2 gm.	110	—12	—1	—8	1.60
	ANDROPOGON CITRATUS DC.					
1.55	Fresh leaves and stems, decoction, 6 gm.=3 gm. dried	111	—7	—33	—38	4.00
1.85	Fresh leaves and stems macerated overnight and then decoction, 4 gm.=2 gm. dried.	115	—29	—36	—37	7.28
	NYMPHAEA NOUCHALI BURM.					
1.55	Leaves, one week dried, 2 gm.	92	—26	—18	—24	7.20
	BIOPHYTUM SENSITIVUM (LINN.) DC.					
1.50	Dried roots and stems, 2 gm.	88	—29	—20	—32	9.40
1.80	Dried roots and stems, 2 gm.	117	—32	—54	—40	8.74

speciosa (banaba) which is now used as standard for comparison. The experience of the natives, as stated in my first paper, that "duhat was for sometime considered the best, but at present it is being superseded by banaba," is thus supported by the experimental results. *Catharanthus roseus* (chitchirica) was found slightly stronger than *Syzygium cumini* but still weaker than *Lagerstroemia speciosa.* Mature leaves of *Ipomoea batatas* (camote or sweet potato) contain no insulinlike principle but the tops of the pink variety contain an amount almost equivalent to that in the old leaves of *Lagerstroemia speciosa. Pithecolobium dulce* (kamatchili), *Ipomoea aquatica* (cancong), and *Tamarindus indica* (sampaloc) were found to contain insulinlike principle less than that in the old leaves of *Lagerstroemia speciosa* but almost equal to that in *Syzygium cumini. Andropogon citratus* (paja de meca, sálai), *Nymphaea nouchali* (lawas or water lily), and *Biophytum sensitivum* (makahiyang lalaki) were found to contain insulinlike principle equal to or slightly more than that in *Lagerstroemia speciosa.*

Although the plants tested were few, yet with the varieties I had chosen, those found to contain the greatest amount of insulinlike principle were sufficient to cover the different applications for which this investigation was carried out. For diabetic patients, who wish to avail themselves of the insulinlike principle and at the same time eat the parts containing it, the tops (talbos) of the colored variety of *Ipomoea batatas* (camote) and the shoots of the colored variety of *Ipomoea aquatica* (cancong) are recommended. For making pharmaceutical preparations the following may be used: *Lagerstroemia speciosa, Catharanthus roseus, Syzygium cumini,* and *Biophytum sensitivum.* For the isolation of insulinlike principle, which may require a large amount of material, *Andropogon citratus* (paja de meca, grass) and *Nymphaea nouchali* (waterlily) are recommended, as they are easily obtainable in great quantities.

CLINICAL APPLICATION

The questions that were asked many times are: Will the preparation of plants found to contain a great amount of insulinlike principle lower the hyperglycemia in diabetes mellitus? What is this active principle? The first question can only be answered by actual tests on diabetic patients. Fortunately, through the coöperation of the doctors of the Philippine General Hospital, clinical tests were conducted to some extent and will be continued especially if good preparation will be made available in the future.

The first case (text fig. 1) was under the service of Dr. Wenceslao Vitug, of the Philippine General Hospital, with Dr. J. C. Cruz as his resident physician. The patient, D. C., was a 55-year old female Filipino, housekeeper, from Malabon, Rizal,

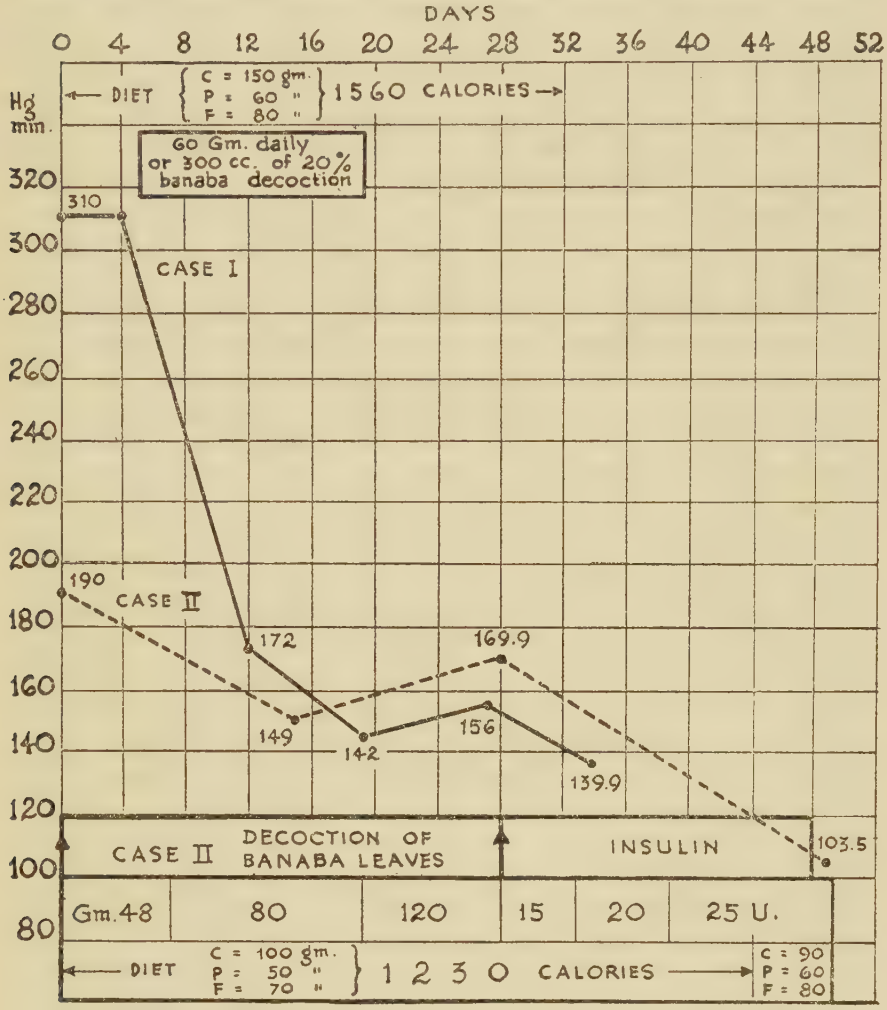

FIG. 1. Chart showing the effects of banaba decoction on Case 1 and Case 2 of diabetes mellitus.

admitted to the hospital on January 2, 1941, for fever, chest pain, and cough. During the first 5 days, she was given full diet, calcium preparations, thiamine, strychnine sulfate, and redoxon. On January 6, 1941, blood sugar determination was requested and the following morning it was reported to be 310 mg. of sugar per 100 cc of blood. At this time her weight was 86.5 lbs. A daily diet of 1,560 calories, consisting of 150

grams carbohydrates, 60 grams proteins, and 80 grams fat, was instituted on January 9, 1941. For five days under this diet the sugar in the urine remained heavy. A decoction of *Lagerstroemia speciosa* was then started on January 14. The dose given of the old leaves was 60 grams daily in the form of 100 cc of 20 per cent decoction three times a day. This dose is equivalent to at least 18 units of insulin daily. Soon after the administration of banaba, the intensity of the reaction of urine by Fehling's test gradually diminished until it became negative 10 days after administration of banaba and remained negative thereafter for the rest of the following two weeks of administration and one week after the administration was stopped. Since then the urine has become sometimes negative or positive to Fehling's test. The blood sugar after 1 week of treatment of banaba was reduced from 310 to 172 mg. and after 2 weeks to 142. When the administration was discontinued the blood sugar rose to 156 mg. a week after, but after a week more with the same diet, it lowered again to 139.9 mg. The patient was discharged, very much improved, one month after the last blood-sugar examination with sometimes negative or positive Fehling's test for sugar in the urine. Unfortunately no blood sugar test had been made before the patient was discharged.

The second case (text fig. 1) was also under the service of Doctor Vitug. The paient, A. F., a 62-year old Spanish mestiza, housekeeper, suffering from diabetes mellitus for six months, was admitted to the hospital for shoulder pain and pricking sensation. On January 9, 1941, she was placed on daily diet of 1,230 calories consisting of 100 grams carbohydrates, 50 grams proteins, and 70 grams fat. Her weight then was 112 lbs. The medicinal treatment during the first three days after her admission consisted of sodium bicarbonate, calcium lactate, Brewer's yeast, and trional. On January 12, 1941, her blood sugar was found to be 190 mg. per 100 cc of blood. Twenty per cent decoction of *Lagerstroemia speciosa* was then started. A daily dose corresponding to 48 grams was given during the first week, and as the urine reaction to Fehling's test remained heavy, the dose was increased to 80 grams daily. At the end of the second week the blood sugar was reduced to 149 mg. The same dose was continued for the third week but, as the urine sugar remained heavy, the dose was increased to 120 grams during the fourth week. Examination of the blood sugar showed a rise to 169.9 mg. in spite of the increased dose. The treatment was

changed to protamine zinc insulin, 15 units for the first 5 days, 20 units for the next 5 days, and 25 units for the last 10 days. The urine sugar was still present in moderate amount even after the administration of 25 units, so the clinician in-charge reduced the diet of carbohydrate by 10 grams. Examination of the blood sugar 5 days after reduction of carbohydrate and continuous administration of protamine zinc insulin for nearly 3 weeks showed a normal amount of 103.5 mg. per 100 cc of blood. The blood-sugar changes in cases I and II are clearly shown in text figs. 1 and 2, respectively.

The preceding two cases taught us a good lesson, for even though there was distinct reduction of blood sugar after the administration of the decoction of *Lagerstroemia speciosa*, this reduction could still be attributed to the calculated diet given. The course of the blood sugar under the given diet, whether going up or down, was not determined. We tried to avoid the mistake in the third and the subsequent cases.

The third case, M.M. (text fig. 2), was also under the service of Doctor Vitug. She was a 30-year old female Filipino, housekeeper, suffering from diabetes mellitus for about 3 years, admitted to the hospital on December 13, 1940, for polyuria and swelling of gums. On December 16, her blood sugar was 188 mg. per 100 cc of blood and her weight was 85 lbs. (39 kg.). Dietetic treatment was instituted on December 18, 19, and 20, 1940, as follows:

Date.	Carbohydrates.	Proteins.	Fat.	Calories.	Blood sugar.
December 18, 1940	100	50	50	=1,050	188
December 19, 1940	110	60	60	=1,220	
December 20, 1940	130	60	60	=1,300	

As the urine sugar increased, the diet was gradually reduced, as follows:

Date.	Carbohydrates.	Proteins.	Fat.	Calories.	Blood sugar.
December 21, 1940	110	50	50	=1,090	
December 24, 1940	100	50	50	=1,050	
December 26, 1940	90	50	50	=1,010	
January 1, 1941					126
January 14, 1941					158.7
January 16, 1941	80	50	50	= 970	

The diet was to be further reduced, but upon my request it was raised for the purpose of experimentation, as follows:

Date.	Carbohydrates.	Proteins.	Fat.	Calories.	Blood sugar.
January 21, 1941	100	50	60	=1,140	
January 23, 1941	110	50	60	=1,220	
January 27, 1941	120	70	70	=1,390	
February 5, 1941	140	80	70	=1,510	
February 14, 1941	140	80	70	=1,510	196.1

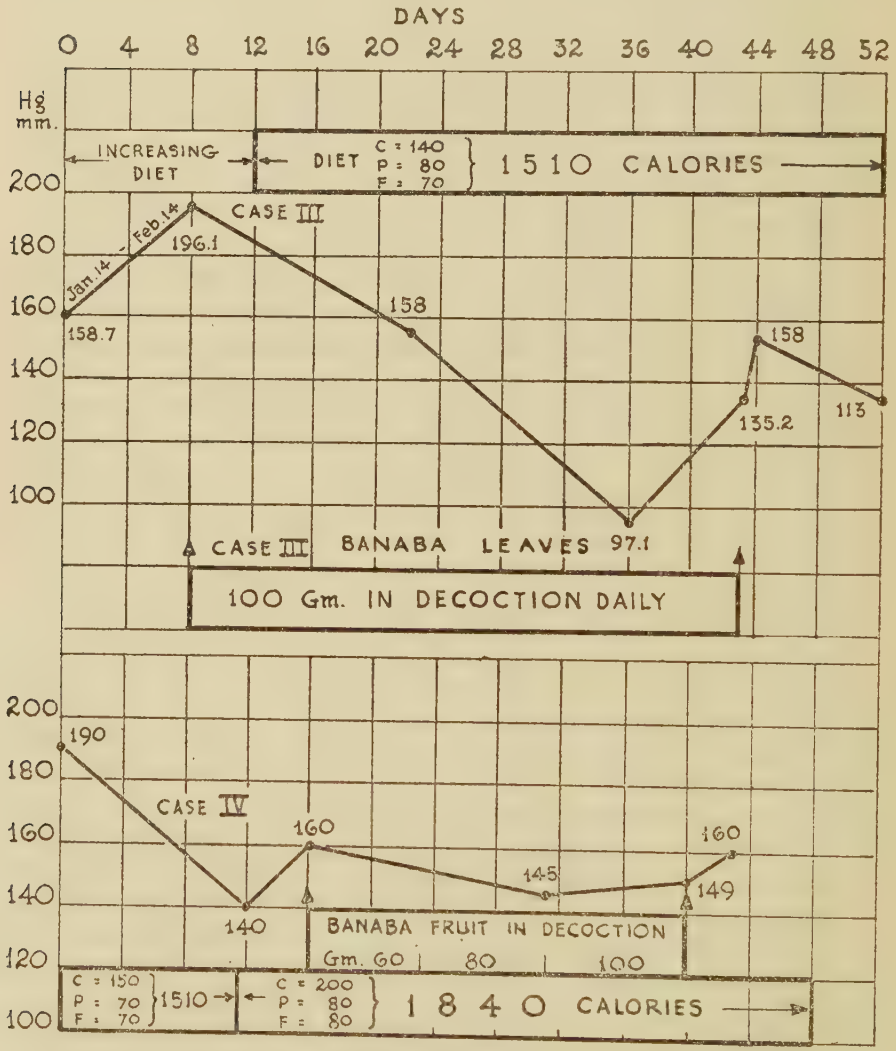

FIG. 2. Chart showing the effects of banaba decoction on Case 3 and Case 4 of diabetes mellitus.

Banaba treatment consisting of 100 cc of 20 per cent decoction 3 times a day was instituted on February 14 until March 17, and the results are as follows: On February 14, blood sugar was 196.1; on February 28, 158; on March 12, 97.1; and on March 17, 135.2. One day after suspension of banaba decoction the blood sugar was 158.0, and on March 26, it was 113.0.

As may be seen in the foregoing treatment, the increase of diet to 1,510 calories caused the blood sugar to rise to 196.1 mg. per 100 cc of blood, which was more than that when she entered. The course of blood sugar in this case is shown in text fig. 2. The effect of banaba treatment was very distinct during the four weeks of treatment. It reduced the blood sugar to normal, 97.1 mg. per 100 cc of blood after three weeks of treatment, but when the treatment was continued for another week and the blood examined at the end of the treatment, the blood sugar was found to have slightly risen to 135.2 mg. After suspension of the treatment for 1 day the blood sugar rose to 158 mg. However, a week after the treatment was stopped, it returned to normal, 113 mg. per 100 cc of blood.

The fourth case, also shown in text fig. 2, was an instance in which a high diet was intentionally given to see if the administration of the decoction of banaba will prevent the rise of blood sugar. This case, a messenger of the Philippine General Hospital, male Filipino, 36 years old, married, was admitted to the hospital on November 3, 1942, for the relief of general body weakness, dimness of vision and polyuria. He was placed under the service of Dr. Regino Navarro, with Drs. Ignacio and Silva assisting. On November 6, 1942, his blood sugar was 190 mg. per 100 cc of blood and his weight was 52.3 kg. A daily diet consisting of 150 grams carbohydrates, 70 grams proteins, and 70 grams fat of a calculated calories of 1,510 was instituted on November 7, 1943. After twelve days under this diet the blood sugar went down to 140 mg. At my request the diet was gradually increased to 1,675 calories on November 21, and then to 1,800 calories on November 23, consisting of 200 grams carbohydrates, 80 grams proteins, and 80 grams fat. The sugar output in the urine greatly increased and the blood sugar on November 27 rose to 160 mg. after 4 days under the latter diet. Decoction of ripe banaba fruits was instituted with the following dosage: 60 grams for the first week, 80 grams for the second week, and 100 grams for the third week. After the second week the blood sugar was 145 mg. and ten days later it was 149 mg. Suspending the decoction and examining the blood sugar

3 days after showed an increase to 160 mg. The diet given was almost of the same amount that he used to take when at work as messenger. When he was discharged, he was taught the method of preparing the decoction, and since then he has been seen at intervals, strong, stout, and with negative or slight sugar in the urine.

The fifth case, text fig. 3, is an illustration of the effect of insulinlike principle obtained from other plants. This case, R. F., was a 37-year old male American, prisoner of war, single, engineer, referred to the hospital from San Lazaro Hospital on September 9, 1942, for glycosuria and furuncolosis. Blood sugar on admission was 410 mg. per 100 cc of blood and his weight was 64.2 kg. On September 11 he was placed on diet consisting of 100 grams carbohydrates, 50 grams proteins, and 60 grams fat, with a calculated value of 1,140 calories. For six days under this diet his blood sugar rose to 540 mg. Insulin was subcutaneously injected, 10 units twice daily for about a week and 20 units twice daily for another week. Blood sugar examination on September 22, 1942, or six days after the insulin injection, showed a blood sugar of 440 mg., and 410 mg. on October 5, and 390 mg. on October 17, 1942. On November 4, 1942, his blood sugar was 440 mg. He was then placed on decoction of 300 gm. daily of the fresh tops of *Ipomoea batatas* (talbos ñg camote) which is equivalent to 60 gm. of dried tops. His diet was increased to 1,600 calories, consisting of 150 grams carbohydrates, 70 grams proteins, and 80 grams fat. After 3 weeks of treatment his blood sugar went down to 330 mg. One week after stopping the treatment the blood sugar rose to 400 mg. Placed on the white powder solution of 0.5 per cent from duhat, giving 5 cc by mouth twice a day for 5 days and then 5 cc three times a day for 7 days, equivalent to 5 and 7.5 centigrams daily, the patient's blood sugar went down to 338 mg.

There were other cases, outside patients, that were tried, with reduction or disappearance of glycosuria, but, as the observation on blood sugar was lacking, they were not included in this paper. In this connection some explanation about the white powder from *Syzygium cumini* (duhat) would serve as a partial answer to the second question. This powder was accidentally isolated during the process of alcoholic extraction of duhat bark by Dr. Josefina Ramos, of the College of Pharmacy. It was noticed that some powder floated on the alcoholic extract and that this was gathered by her laboratory helper, although in small amount, and labeled by somebody as "extract of duhat."

Unfortunately that somebody could not be identified when I tried to find out more information about the powder. Doctor Ramos believed it to be only mineral that separated during the extraction. However, when I tested the hypoglycemic effect I was surprised to find its effectiveness in lowering blood sugar by oral administration and by subcutaneous injection. The data of the experimental findings are given in Table 2. As shown in this table, 1 cc of 0.5 per cent solution, or 5 mg. of the powder,

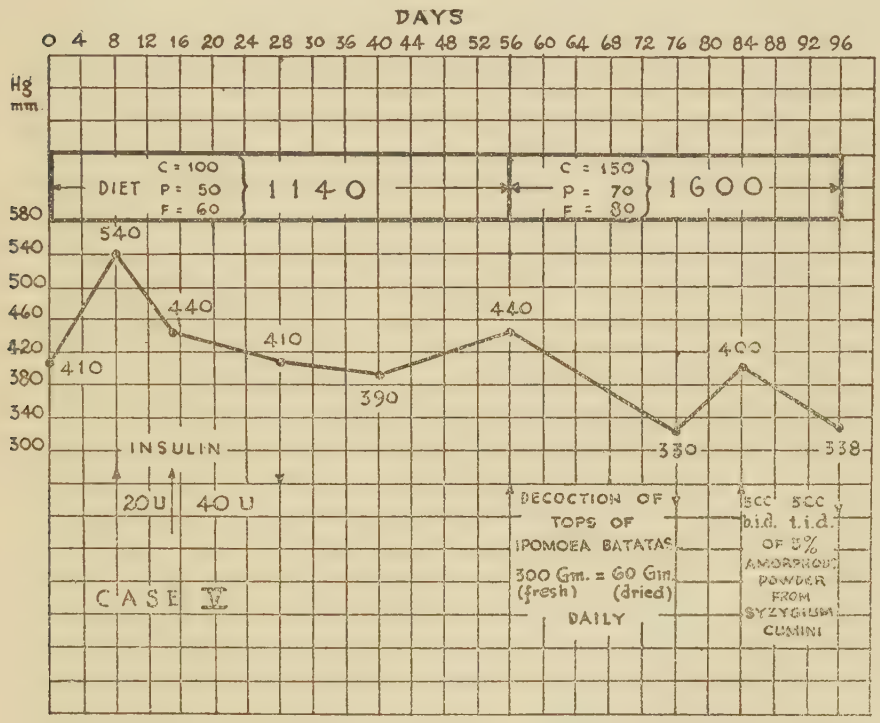

FIG. 3. Chart showing the effects of decoction of tops of *Ipomoea batatas* and the solution of powder from *Syzygium cumini* on Case 5 of diabetes mellitus.

is equivalent to at least 2.2 units. Based upon this unitage, the dose given to the fifth patient ranged from at least 22 to 33 units daily with the amount given of 10 to 15 cc. of 0.5 per cent solution. The powder readily dissolved in solution with the addition of a small amount of dilute acid and the solution did not produce any of the characteristic reactions of alkaloid, glucoside, and tannin. It was light brownish-white amorphous powder, odorless and slightly bitter. One gram of this powder has a value of 440 units of insulin when administered orally and twice this strength when injected subcutaneously.

TABLE 2.—*Equivalent insulin units of white powder from Syzygium cumini as determined by its hypoglycemic effect in rabbits.*

Weight of rabbits.	Preparations employed and dosage.	Initial blood sugar.	Reduction of blood sugar after—			Unit per cc of 0.5 per cent solution.
			1½ hours.	3 hours.	5 hours.	
kg.	Subcutaneous injections of:	*mg.*	*mg.*	*mg.*	*mg.*	
1.80	0.05 cc x kg. of 0.5 per cent solution of crystal powder	109	—4	—6	—16	4.03
1.75	0.2 cc x kg. of 0.5 per cent solution of crystal powder	89	—21	—28	—26	4.26
	Oral administration of:					
1.60	0.4 cc x kg. of 0.5 per cent solution	91	—24	—31	—23	2.20
1.75	0.2 cc x kg. of 0.5 per cent solution	98	—19	—26	—25	3.20
1.60	0.2 cc x kg. of 3 weeks old 0.5 per cent solution	84	—2	—3	—21	1.65

As additional support to the statement that the active principle can be isolated in the form of powder, I refer to the work of Miss Lourdes Ocampo who, under the advice of Dr. A. C. Santos, isolated a small amount of white powder from 5 kg. of old banaba leaves. When I injected a very small amount of it intravenously in a dog, a marked fall of blood sugar was produced. Because of the limited amount of the powder she had isolated, additional tests could not be performed.

DISCUSSION

The insulinlike principle is distributed in the different plants tested. The parts of the plant containing the greatest amount are not definite, for, while in *Lagerstroemia speciosa* the bark was found to contain small amount as published in my second paper, in the case of *Syzygium cumini* the same part (bark) was found to contain relatively moderate or sufficient amount. In many plants the mature leaves were found to contain moderate amount and less in the young, but in the case of *Ipomoea batatas* the mature leaves were found to have none, while the young or tops contained a great amount. Deterioration of the insulinlike principle on keeping was observed in that found in different plants just as it occurred in the different parts of *Lagerstroemia speciosa* as shown in my second report.(2) The first four cases of diabetes mellitus treated with decoction of the old leaves or ripe fruits of *Lagerstroemia speciosa* showed that blood sugar can be reduced after two to four weeks of treatment. In the first two cases the reduction can be attributed to diet, but in the third and fourth cases this factor was eliminated, for there was evidence that the tendency with the given diet before treatment was towards a rise. In the fourth case, where liberal diet was given, the decoction did not only stop the rise but even reduced the blood sugar. In the fifth case decoction of the tops of *Ipomoea batatas* distinctly reduced the blood sugar, and the white powder from *Syzygium cumini* with a daily dose of from 5 to 7.5 centigrams administered orally, also distinctly reduced the blood sugar. In all cases, soon after suspension of the decoction, the blood sugar rose, but after sometimes the blood sugar lowered again even if the decoction was not given. The rise was to be expected, but the subsequent fall of blood sugar would need some explanation. It is possible that suspension of the insulinlike principle which causes a rise of blood sugar might have stimulated the pancreas that might have partially recovered after having been given rest during the treat-

ment, to function more actively thus lowering the blood sugar from the preliminary rise immediately after suspension of the decoction.

SUMMARY AND CONCLUSION

1. The different plants examined were found to contain insulinlike principle in some parts of each in greatest amount.

2. For diabetic persons who wish to avail themselves of the insulinlike principle and at the same time eat the parts containing it, the "talbos ñg camote," or the tops of the colored variety of *Ipomoea batatas,* and the shoots of "cancong," or *Ipomoea aquatica,* are recommended.

3. For making pharmaceutical preparations the following which contain sufficient amount of insulinlike principle are available: *Lagerstroemia speciosa, Catharanthus roseus, Syzygium cumini,* and *Biophytum sensitivum.*

4. For isolating the insulinlike principle, *Andropogon citratus* and *Nymphaea nouchali* are recommended, for they are easily obtainable in great quantities.

5. In the four well-observed clinical cases, where decoction of *Lagerstroemia speciosa* was administered orally, the blood sugar reduction to about normal occurred in all cases. The factor of diet in lowering blood sugar was completely eliminated in the third and fourth cases.

6. In the fifth case the decoction of tops of *Ipomoea batatas* administered for three weeks lowered the blood sugar from 440 to 330 mg. per 100 cc of blood.

7. In the case of the white powder isolated from *Syzygium cumini,* the blood sugar was reduced from 400 to 338 mg. per 100 cc of blood by daily administration of 5 centigrams for 5 days, and 7.5 centigrams for 7 days, which are equivalent to at least 22 and 33 units of insulin daily, respectively.

8. The decoction is not a suitable preparation for a prolonged use, as the administration of 20 units would require a large volume, such as 100 cc three times a day of 20 per cent. Thus it would be desirable that some concentrated pharmaceutical preparation or solution or other preparation of the isolated principle be made in the future.

9. The insulinlike principle can be isolated in powder form as was already shown by the accidental separation of the amorphous powder in a small amount during the process of extraction of *Syzygium cumini* bark and the small amount of white powder obtained from the extraction of several kilos of the old leaves

of *Lagerstroemia speciosa* which also possesses a high hypoglycemic property.

10. The powder accidentally isolated does not possess alkaloidal, glucosidal, and tannin properties. It is a light brownish-white amorphous powder, odorless and slightly bitter. One gram of it has a value of 440 units of insulin when administered orally and twice that strength when administered subcutaneously.

ACKNOWLEDGMENT

I wish to extend my thanks and appreciation to Dr. Wilfrido de Leon, of the Institute of Hygiene, whose scientific interest has enabled me to carry out this investigation by lending two rabbits every week for experimental use; to Dr. A. G. Sison, Director of the Philippine General Hospital; to Dr. Luis Guerrero, Chief, Department of Medicine; to Drs. Vitug and Navarro and their associates under whose services the clinical tests were made feasible; and to Dr. Eduardo Quisumbing for helping me in getting the modern names of the plants that were tested.

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2. GARCIA, F. Distribution and deterioration of insulin-like principle in Lagerstroemia speciosa (banaba). Acta Medica Philippina 3 No. 1 (1941) 99–104.
3. New and non-official remedies; Insulin. Amer. Med. Assoc., Chicago (1936) 235.
4. MERRILL, E. D. Enumeration of Philippine Flowering Plants. Bureau of Printing, Manila, (1923). 1:43; 2:140, 256, 324; 3:137, 164, 323, 364, and 368.

ILLUSTRATIONS

FIG. 1. Chart showing the effects of banaba decoction on Case 1 and Case 2 of diabetes mellitus.

2. Chart showing the effects of banaba decoction on Case 3 and Case 4 of diabetes mellitus.

3. Chart showing the effects of decoction of tops of *Ipomoea batatas* and the solution of powder from *Syzygium cumini* on Case 5 of diabetes mellitus.

SOME PHILIPPINE CLAYS AS POSSIBLE BLEACHING AGENT FOR LOCAL VEGETABLE OILS

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Different types of clay have been used in medicine from time immemorial either as external or internal remedies. According to Remington [1] and others, the value of these remedies appears to reside in their absorbing properties, although there are some who attribute to them direct antiseptic action. The variety commonly known as Fuller's earth has a much higher absorbing power than kaolin. Because of its property of absorbing large amounts of liquid, Fuller's earth is used for many pharmaceutical purposes, especially in the preparation of pills. Not only, however, will it mechanically hold considerable liquid, but further has the property of separating many dissolved substances from solutions. To what this absorbing power is due, is at present somewhat obscure, although it appears to be in part dependent upon the colloidal nature of the earth. Kingzett [2] attributes this absorbing action of Fuller's earth, to the combination of mechanical and electrical properties, the active constituents being probably hydrated silica and hydrated alumina.

Other investigators [3] have found out that no definite relationship exists between the absorptive powers and the chemical compositions of clays.

Fuller's earth is extensively used in the mineral and vegetable oil industries as a clarifying and bleaching agent. The Philippines, from 1934 to 1938, imported annually about a million and a half kilos of Fuller's earth valued at 23,000 pesos. The greater portion, if not all of this earth, is used in bleaching refined coconut oil for edible purposes.

If a cheap bleaching agent could be found from local materials, then even our commercial coconut oil whose color reading

[1] The Dispensatory of the United States of America ed. 20 (1918) 605.
[2] Chem. Encyclopoedia (1932) 377.
[3] Natural and Applied Science Bull. 5 (1936) 159.

usually runs as high as 6.6 Red and 39 Yellow could be bleached. Dark-colored oils, which are valued very low at present, could be bleached to the desired lightness in color. The coconut oil exported is valued according to the degree of coloring and the percentage of free fatty acids it contains.

The clays are either used in their natural state or are sometimes especially treated in order to increase their bleaching efficiency.

The two essential points that should be remembered in the use of clays for the oil industry are (1) bleaching efficiency or removal of the coloring matter from the oil, and (2) minimum loss of oil due to absorption.

This investigation was therefore undertaken with the idea of testing some Philippine clays as possible bleaching agent for coconut oil and other vegetable oils and comparing the results with those obtained by using imported Fuller's earth.

EXPERIMENTAL PROCEDURE

The samples of clay used in this investigation were named after the place of origin. Sample a was taken from Rosario, Pasig, Rizal; b, from Pansol, Laguna; c, from Siruma, Camarines Norte; d, from the Ceramic Industries of the Philippines at Balintawak, Caloocan, Rizal; e, collected by the former Division of Soil Survey, from Buenavista Estate; and f, submitted by a certain Mr. Hubbard, who gave the information that the said sample had been taken from a deposit in the former U. S. Reservation in Bataan Province.

In the preparation of the clays for the test, each sample as received was first dried in the oven and then powdered to pass through a 100-mesh sieve. It was again placed in the oven heated at 105°C. until free of moisture. This powdered dry clay was labeled as the natural sample.

The treated sample was obtained by taking a portion of the powdered clay (natural) and boiling it with 5 per cent dilute hydrochloric acid for about thirty minutes. For every gram sample, 10 cubic centimeters of the diluted acid were used. The mixture was then allowed to settle and the product washed by decantation until free of acid. The washed clay was then dried, ground, and passed through the 100-mesh sieve.

The bleaching efficiency of the clays was determined according to the Bleach Test as described by Jamieson,[4] using, however,

[4] Jamieson, G. S., Vegetable Fats and Oils (1932) 398.

different percentages of earth. Three hundred grams of the oil were weighed into a pyrex beaker 4 inches in diameter and 5½ inches deep with about 1,000 cubic centimeters capacity. This oil was heated to 120°C. and the required amount of clay added. It was stirred at 250 r. p. m. (±5) for 5 minutes, not allowing the temperature to fall below 105° C., and then filtered through filter paper. After sufficient oil has filtered to insure clearness, a sample was collected and the color determined according to the method adopted by the Coconut Oil Manufacturers of the Philippines (1924). The oil used in all the tests is a commercial grade coconut oil of a color reading of 4.2 Red and 27.0 Yellow. The results of the bleaching test are recorded in Table 1.

TABLE 1.—*Color readings of coconut oil bleached with different percentages of Philippine clays and imported Fuller's earth.*

Clays.	Percentages of bleaching agent used.							
	2		4		6		8	
	Red.	Yellow.	Red.	Yellow.	Red.	Yellow.	Red.	Yellow.
Philippine—								
a. Rosario:								
1. Natural	3.7	21.0	2.3	15.0	2.0	12.0	1.9	9.0
2. Treated	2.0	12.0	1.2	9.0	1.1	9.0	1.1	9.0
b. Pansol:								
1. Natural	2.2	15.0	1.8	9.0	1.3	9.0	1.3	9.0
2. Treated	3.1	21.0	2.0	12.0	1.9	9.0	1.4	9.0
c. Siruma:								
1. Natural	------	-------	------	-------	5.2	33.0	------	-------
2. Treated	------	-------	------	-------	5.0	30.0	------	-------
d. Balintawak:								
1. Natural	3.1	21.0	2.1	15.0	1.7	9.0	1.3	9.0
2. Treated	2.2	15.0	1.6	9.0	1.1	9.0	1.1	9.0
e. Buenavista:								
1. Natural	2.9	15.0	1.9	9.0	1.5	9.0	1.1	9.0
2. Treated	2.9	15.0	2.1	15.0	1.9	9.0	1.9	9.0
f. Bataan:								
1. Natural	2.1	15.0	1.5	9.0	1.0	6.0	1.0	6.0
2. Treated	2.0	12.0	1.2	9.0	1.0	6.0	1.0	6.0
Imported—								
a. Fuller's earth 1	2.0	12.0	1.1	9.0	1.1	9.0	1.0	6.0
b. Fuller's earth 2	1.5	9.0	1.0	6.0	1.0	6.0	1.0	6

As shown by the data Rosario and Balintawak clays have better bleaching properties when specially treated than when they are used in their natural state. These treated samples have about the same decolorizing efficiency as the imported

Fuller's earth 1, though lower than that of Fuller's earth 2. There was a slight improvement in the Bataan clay when treated; Siruma increased the color of the oil instead of bleaching it. On the other hand samples from Pansol and Buenavista gave better results when used in their natural state than when treated.

In determining the loss of oil due to absorption, the procedure for the Bleach Test was followed but modified in that the filtration was done by means of a Buchner funnel as suggested by Richert.[5] When the clay seemed to be dry, vacuum being kept up for 15 minutes, it was removed from the funnel and weighed. The amount of clay used in this test was 6 per cent. In Table 2 are given the results on the absorption of oil by some Philippine clays and two samples of imported earth for comparison.

TABLE 2.—*Absorption of oil by some Philippine clays and two samples of imported Fuller's earth.*

Bleaching agent used.	Bleaching agent plus oil.	Oil absorbed.
Philippine Clays—		
a. Rosario:	*Grams.*	*Per cent.*
1. Natural	21.9728	22.07
2. Treated	23.6030	31.12
b. Pansol:		
1. Natural	29.6172	64.54
2. Treated	29.0930	61.62
c. Siruma		
d. Balintawak:		
1. Natural	22.6058	25.58
2. Treated	23.7110	31.72
e. Buenavista:		
1. Natural	18.7734	12.89
2. Treated	19.1570	19.28
f. Bataan:		
1. Natural	27.4670	52.60
2. Treated	27.0165	50.10
Imported—		
a. Fuller's earth 1	32.2632	79.24
b. Fuller's earth 2	24.9058	38.36

As shown by the data, Rosario, Balintawak, and Buenavista clays absorbed less oil than the imported earth, Buenavista giving the lowest percentage of oil absorbed. Pansol and Bataan clays gave lower percentage loss of oil than the imported earth 1, but higher than that of earth 2.

[5] Journ. Ind. Eng. Chem. 9 (1917) 599.

SUMMARY AND CONCLUSION

The results from the six samples tested show that the Philippine clays differ in their bleaching efficiency, with the exception of Siruma, which increased the color of the original oil. When specially treated, Rosario and Balintawak clays gave about the same bleaching efficiency as imported Fuller's earth 1, although lower than that of earth 2. However, the two local clays have the advantage in that the loss of oil due to absorption is lower as compared with the imported earth. In the Buenavista clay, both the natural and the treated samples have less amount of oil absorbed, but not so efficient for bleaching purposes. Clays from Pansol and Bataan are the best among the local samples for decolorizing purposes as no special treatment is necessary.

From the foregoing results, it is evident that there are a number of clays found in the Philippines that can be used for clarifying and bleaching purposes in place of the imported Fuller's earth for the local vegetable oil industry.

GLAZING PHILIPPINE POTTERY WARE

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Deposits of clays have been found in various localities in the Philippines and some investigations [1] have been carried out to ascertain the characteristics of these clays.

Reports [2] have also been made on the native methods for manufacturing ceramic ware. These products consist of articles such as flower pots, vases, bricks, vats, water jugs, and tinajas. Those sold in and around Manila are made mostly by the potteries of San Pedro Makati, Rizal Province. In some of these potteries glazed flower pots of various sizes, shapes and colors, ranging from bluish green to reddish brown, are made. Because of the secrecy exercised in making the glazes and of the fact that the Philippine potters have not developed this art, this line of ceramics is completely in the hands of foreigners, mostly Chinese.

This paper reports some experiments made on the glazing of San Pedro Makati pottery ware. Both raw ware and biscuits were used in this study.

RAW WARE AND BISCUITS

The raw ware is generally made as follows:

Red clay from the town of Rosario, Rizal Province, is loaded in bancas and carried to San Pedro Makati where it is piled near a pit which is about 4 meters deep and from 1 to 1.3 meters in diameter. The clay is dropped into the pit until about a quarter of it is filled. River water is added in small portions until the pit is nearly full. The mixture is stirred continuously,

[1] Cox, A. J., Philip. Journ. Sci. § A 2 (1907) 413.
Ibid. § A 3 (1908) 377.
Adams, C. I., and W. E. Pratt, Ibid. § A 5 (1910) 143.
Witt, J. C., Ibid. § A 11 (1916) 203.

[2] Witt, J. C., Philip. Journ. Sci. § A 8 (1918) 59.
Christie, E. B., Ibid. § D 9 (1914) 117.
Crowe, C. H., Trans. Amer. Cer. Soc. 14 (1912) 723.

using wooden stirrers, or paddles, so as to suspend and disintegrate the clay. The liquid is discharged to another pit of similar size and shape by pouring through a sieve of about 25 mesh, using petroleum cans for the purpose. Water is again added to further dilute the mixture and the stirring is continued. The clayey liquid is finally discharged into an open rectangular plot (about 5 by 8 meters) which is floored with broken ware. The wide surface facilitates evaporation of most of the water. The semisolid material is collected and deposited under a nearby shed to age. To prevent excessive evaporation, the pile is covered with wet sacks.

A portion of the material is pugged by treading with the feet and, when thoroughly mixed, it is ready for making the ware either with or without the use of molds on the potter's wheel. The finished ware is dried inside the shed for more than a week and is then ready for biscuit firing. Unburned air-dried ware is called raw ware and the fired ware is known as biscuits. Only the biscuits are used for glazing.

ANALYSES AND TESTS

The analyses and tests made on a representative sample of local pottery clay are given in the following tables. Only standard methods, with slight modifications, were used.

TABLE 1.—*Analysis of Philippine pottery clay.*[a]

Constituent.	Per cent.
Silica (SiO_2)	50.06
Alumina (Al_2O_3)	19.16
Iron oxide (Fe_2O_3)	8.54
Lime (CaO)	2.23
Magnesia (MgO)	2.42
Potash (K_2O)	0.81
Soda (Na_2O)	2.25
Loss on ignition	13.95

[a] Analysis made by Mr. Jose Roco, of the Division of Tests and Standards, Bureau of Science.

TABLE 2.—*Rational analysis of Philippine pottery clay.*[a]

Constituent.	Per cent.
Kaolinite	26.76
Orthoclase	4.78
Albite	19.03
Anorthite	11.06
Free silica	18.74
Limonite	9.50
Magnesium carbonate	5.06
Water at 100° C.	7.38

[a] The results are calculated from the chemical analysis.

Table 1 shows the chemical analysis and Table 2 the rational analysis of the clay. The latter was calculated by following the method of Washington [3] as used by Ries.[4] An examination of Table 2 shows that the sum of the percentages of orthoclase, albite, and anorthite (total feldspar) is 34.87. This large amount accounts for the low fusing point of the clay.

TABLE 3.—*Physical tests of Philippine pottery clay.*

Water of plasticity (per cent)	34.66
Volume shrinkage (per cent)	52.62
Linear shrinkage [a] (per cent)	22.03
Tensile strength [b]	([d])
Transverse strength [b]	270.0
Slaking time (min.)	80
Drying qualities (room temperature)	good
Approximate fusing point (°C.)	1,180
Moisture [c] (per cent)	5.67

[a] Calculated from volume shrinkage.
[b] Pounds per square inch.
[c] Material sieved through 20 mesh.
[d] The test pieces cracked in the testing machine.

The physical tests are given in Table 3. The tensile strength is nil which suggests the careful handling of the raw ware. The transverse strength is 270 pounds. Although the shrinkage is quite high, yet the drying qualities at room temperature are good. Because of the low fusing point, only lead glazes can be employed in using this clay.

TABLE 4.—*Mechanical analysis of Philippine pottery clay.*

Constituent.	Per cent.
Clay substance	55.66
Silt	10.81
Dust sand	8.85
Fine sand	24.91
Coarse sand	0.16

Table 4 gives the mechanical analysis of the sample. Although the percentage of clay is high, there is a considerable amount of silt, dust sand, and fine sand. The presence of these impurities makes the clay somewhat porous. This condition helps in the rapid evaporation of the water, thus confirming the good drying qualities at room temperature.

[3] Amer. Cer. Soc. 1 (1918) 405.
[4] Clays, their occurrence, properties and uses. John Wiley and Sons, Inc., New York (1927).

PREPARATION, APPLICATION AND FIRING OF GLAZES

To prepare a glaze for the biscuit, which was prepared from the clay, the chemical composition of the latter should be determined. Following the method of Seger,[5] the molecular composition of the clay may be calculated from the percentage composition by dividing the percentage of each constituent by the corresponding molecular weight. The results obtained are given in Table 5.

TABLE 5.—*Molecular composition of pottery clay.*

Constituent.	Percentage composition. [a]	Molecular weight.	Molecular composition.
Silica (SiO_2)	58.2	60	0.970
Alumina (Al_2O_3)	22.3	103	0.216
Iron oxide (Fe_2O_3)	9.9	160	0.062
Lime (CaO)	2.6	56	0.046
Magnesia (MgO)	2.8	40	0.070
Potash (K_2O)	0.94	94	0.010
Soda (Na_2O)	2.6	62	0.042

[a] Calculated from the chemical analysis.

For convenience, the sum of the percentages of the fluxes CaO, MgO, K_2O and Na_2O may be represented by the symbol RO; and the sum of the percentages of Al_2O_3 and Fe_2O_3 may be designated by the symbol R_2O_3. Accordingly, the molecular formula of the clay may be stated as follows:

$$(RO)\ (1.65\ R_2O_3)\ (5.77\ SiO_2)$$

Based on the above formula, the molecular formula for the glaze may be calculated as follows:

$$(0.2\ RO + 0.8\ PbO)\ (0.33\ R_2O_3)\ (1.154\ SiO_2)$$

An examination of the formula above shows that the ratio of total RO to SiO_2 is 1:0.58, considering that 3RO is equivalent to 1 R_2O_3. Glasses have a ratio of 1RO: 2.5 SiO_2 with practically no Al_2O_3. Glazes containing lead have a ratio as low as 1:1.17 with about 0.1 mole of Al_2O_3. In this study the ratio which gave the best results was from 1:1.27 to 1:1.37. The corrected formula is given below:

$$(0.2\ RO + 0.8\ PbO)\ (0.33\ R_2O_3)\ (2.53\ SiO_2)$$

[5] Collected Writings 2 (1902) 1114.

Rice-hull ash which contained from 94 to 96 per cent SiO_2 was added to correct the deficiency in silica. The weights of the ingredients are as follows:

	Grams.
Grog	8.0
Clay	4.08
Red lead	18.30
Rice-hull ash	8.6

The same clay, fired at about 750° C., and powdered to pass 100 mesh, is called the grog. The grog was added to correct the tendency of the glaze to rise as the temperature increases.

The mixture was ground wet to a paste on a ground glass. After diluting with water to a paint consistency, it was applied with a brush on a slightly wetted biscuit. The biscuit which was dried in air and then in an oven was finally fired in an electric muffle. A red shiny glaze that matured between 920° and 980°C., was obtained. Long crazes developed on cooling.

The formula was further corrected and the following was finally adopted:

$$(0.25\ RO + 0.75\ PbO)\ (0.41\ R_2O_3)\ (3.04\ SiO_2)$$

The weights of the ingredients are as follows:

	Grams.
Grog	10.0
Clay	5.2
Rice-hull ash	10.1
Red lead	17.2

The above glaze matured between 920° and 980° C., giving a reddish-brown glaze on the Rosario clay biscuit. It was observed, however, that the glaze did not give uniform results when prepared in larger quantities because of the tendency of red lead to settle at the bottom. This defect was corrected by fritting part of the materials. The frit consisted of the following:

	Grams.
Grog	20.0
Red lead	34.4
Rice-hull ash	20.2

For the final compounding of the glaze there was added raw clay amounting to 0.52 gram for every 3.63 grams of frit used. The mixture was finally powdered wet in a ball mill. The glaze obtained was uniform.

By using the preceding formula a clear fritted overglaze was also developed using Pansol clay. The chemical analysis of this clay is shown in Table 6.

TABLE 6.—*Analysis of Philippine Pansol clay.*[a]

Constituent.	Per cent.
Silica (SiO_2)	49.62
Alumina (Al_2O_3)	31.68
Iron oxide (Fe_2O_3)	1.29
Lime (CaO)	0.86
Magnesia (MgO)	0.33
Potash (K_2O)	0.38
Soda (Na_2O)	0.34
Loss on ignition	14.68

[a] Analysis made by Mr. Jose Roco, of the Division of Tests and Standards, Bureau of Science.

Following the method used in calculating the molecular formula for the pottery clay, we obtained the following formula for the Pansol clay:

$$(RO)\ (10.25\ R_2O_3)\ (27\ SiO_2).$$

Using lime as part of RO, we deduce the following glaze formula:

$$(0.02\ RO + 0.18\ CaO + 0.80\ PbO)\ (0.2\ R_2O_3)\ (0.54\ SiO_2)$$

In order to make the ratio 1:1.30, like the pottery glaze, it was necessary to make a correction. The corrected formula follows: $(0.02\ RO + 0.18\ CaO + 0.80\ PbO)\ (0.2\ R_2O_3)\ (2.08\ SiO_2)$. As it was found that the glaze was not very fusible, addition of $0.2\ B_2O_3$ was made. The glaze matured between 900° and 950°C. with short crazes. Further corrections gave the following final formula:

$$(0.02\ RO + 0.18\ CaO + 0.80\ PbO)\ (0.2\ R_2O_3)\ (2.08\ SiO_2 + 0.2\ B_2O_3)$$

In preparing the above glaze, fritting was necessary. The frit was composed of the following:

	Grams.
Grog	7.2
Lime carbonate	3.6
White lead	41.4
Rice-hull ash	19.4
Boric acid	5.0

For the final compounding of the glaze, 0.18 gram of clay was added for every 3.41 grams of frit.

The use of flint bottles in the compounding of glaze was tried. Generally, a flint bottle (ordinary white glass) has a molecular

of (RO) (2.5 SiO_2). The analysis of this bottle is shown in Table 7.

TABLE 7.—*Analysis of a flint (clean glass) bottle.*[a]

Constituent.	Per cent.
Alumina (Al_2O_3)	0.53
Lime (CaO)	6.37
Magnesia (MgO)	2.83
Soda (Na_2O)	17.80
Silica (SiO_2) by difference	72.47

[a] Lagenbeck, K. The chemistry of pottery. Chemical Publishing Co., Easton, Pa. (1895).

The alumina in the glass is considered an impurity. The molecular formula of the glass was calculated in the same way as the clay molecular formula, as shown below:

$$(0.61\ Na_2O + 0.24\ CaO + 0.15\ MgO)\ (2.56\ SiO_2)$$

As previously mentioned, alumina is a necessary ingredient in glazes. In pottery glazes, it amounts usually to 0.2 mole. The following is the mixture that matured between 920° and 980° C. after a series of trials:

	Grams.
Flint glass	10.50
Rice-hull ash	6.10
Red lead	11.20
Pansol clay	5.20

The molecular formula of the above mixture is:

$$(0.5\ RO + 0.5\ PbO)\ (0.2\ Al_2O_3)\ (2.56\ SiO_2)$$

In this formula, the 0.5 RO consists of the following:

$$\tfrac{1}{2}\ [(0.61\ Na_2O + 0.24\ CaO + 0.15\ MgO)\ (2.56\ SiO_2)]$$

The fired ware was reddish brown and had short crazes.

In the production of other colored wares, the use of colored engobes was tried. Such engobes consist of a watery mixture of clay and inorganic coloring matter. After repeated trials, the mixture adopted was composed of 90 per cent grog and 10 per cent clay, both from Pansol. Gum acacia, amounting to 2 per cent of the mixture, was used as a sticker. A paint consistency of this mixture was prepared with the addition of metallic colors like Fe_2O_3, Cr_2O_3, and CoO. The colored engobes were painted on the raw ware with no deleterious effect. After air and oven drying, they were biscuited in the electric muffle at around 750° to 800° C. When this colored biscuit was overglazed, there was produced a beautiful glaze-colored ware.

SUMMARY

The chemical and mechanical analyses and physical tests were made on the Rosario pottery clay as used in the San Pedro Makati district.

A glaze, made from the San Pedro Makati clay, was developed for the biscuit, with the use of the same clay with addition of rice-hull ash and red lead.

There was also developed an overglaze composed of Pansol clay, lime carbonate, white lead, rice-hull ash and boric acid.

From ordinary flint (white) bottles a glaze was made by the addition of Pansol clay, rice-hull ash, and red lead.

Rice-hull ash is a good source of silica in glazing local pottery ware.

The use of colored engobes for producing colored ware, using Pansol clay, was satisfactory.

NEW OR INTERESTING PHILIPPINE PLANTS, II

By EDUARDO QUISUMBING

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The present paper, like the preceding one, is largely composed of the descriptions of fifteen apparently undescribed species in various families which have been worked out from time to time during the past few years.[1] Two species previously described by various authors from extra-Philippine material are here recorded from the Archipelago for the first time. Following the rules of priority some nomenclatural changes are included. Unless otherwise indicated in the text, the types of the new species are deposited in the Philippine National Herbarium.

JUGLANDACEÆ

Genus ENGELHARDTIA Leschenault

ENGELHARDTIA SERRATA Blume.

Engelhardtia serrata BLUME, Fl. Jav. Juglandeae 2 (1826–36) 14, *t. 4 et 5c;* MIQ., Fl. Ind. Bat. 1[1] (1856) 843; C. DC. Prodr. 16[2] (1864) 141; HOOK F., Fl. Brit. Ind. 5 (1890) 596; KOORD. ET VALET., Bijdr. Booms. Java 5 (1900) 172, Atlas Baumarten Java 4 (1918) *f. 699;* KOORD. Excursionsfl. Java 2 (1912) 53, *f. 7.*
Engelhardtia palembanica MIQ., Fl. Ind. Bat. Suppl. (1861) 346.

MINDANAO, Surigao Province, Placer, *Wenzel 3015* (female plant), *3015a* (male plant), *3006* (male plant), August, 1927. A species not previously reported from the Philippines, Java, Penang, and probably in Borneo and Celebes. With the exception of the leaves, which are pubescent on both surfaces, the slender peduncles and the stigmas of the specimens cited closely match Blume's figure and description. The two stigmas are often bifid.

MORACEÆ

Genus FICUS Linnæus

FICUS DELTOIDEA Jack.

Ficus deltoidea JACK, Malay Misc. 7 (1822) 71.
Ficus ovoidea JACK, Malay Misc. 7 (1822) 71.

[1] Philip. Journ. Sci. 41 (1930) 315–371.

Ficus diversifolia BLUME, Bijdr. (1825) 456; MIQ., Fl. Ind. Bot. 1[2] (1859) 328; HOOK. F., Fl. Brit. Ind. 5 (1888) 529; WINKLER in Engl. Bot. Jahrb. 49 (1913) 365; RIDLEY, Fl. Malay Penin. 3 (1924) 346; MERR., Journ. Royal As. Soc. Straits Branch Spec. No. (1921) 222; MIQ., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 269, 289; CORNER, Wayside Trees of Malaya 1 (1940) 687.

Ficus diversifolia BLUME var. *lutescens* (Desf.) KING in Ann. Bot. Gard. Calcutta 1 (1887) 140; WINKLER in Engl. Bot. Jahrb. 49 (1913) 365; MERR., Journ. Royal Soc. Straits Branch, Spec. No. (1921) 223.

Ficus spathulata MIQ. in Hook. London Journ. Bot. 7 (1848) 441.

Ficus sideroxifolia GRIFF., Not. 4 (1854) 389, Ic. Pl. As. 4 (1854) *t. 551, f. 2.*

Ficus lutescens DESF., Cat. Hort. Par. ed. 3 (1829) 413.

Synoecia diversifolia MIQ. in Hook. Journ. Bot. 7 (1848) 470, *t. 9B.*

Erythrogyne frutescens VISIANI in Gaspar Ricerch. Caprif. Fic. (1845) 86; MIQ. in Hook. London Journ. Bot. 7 (1848) 453.

Apparently of the bush type, glabrous. Leaves 1.5 to 7.5 centimeters long, 0.7 to 5.2 centimeters wide, deltoid or cuneate-obovate, the apex broadly truncate to rounded, narrowed to the acute base, chartaceous, rusty-olive beneath, midrib forked, with a dark-brown bland at the fork of the midrib beneath; petiole 0.5 to 1.5 centimeters long. Fruit solitary or in pairs, axillary, rounded, 4 to 8 millimeters in diameter; peduncle 7 to 10 millimeters long.

PALAWAN, Tiglaplan River, *Bur. Sci. 77650 Edaño,* April 24, 1929, on forested slopes, altitude about 450 meters; *Bur. Sci. 77482 Edaño,* April 15, 1929, altitude about 1,700 meters. Very common in Borneo, Sumatra, Malay Peninsula, etc.

The species is new to the Philippines, but for it I accept Jack's specific name which is three years older than Blume's, and there is no doubt as to the identity of Blume's species with that described by Jack. It is characterized by its deltoid or cuneate-obovate, blunt leaves which are rusty-olive beneath and the presence of a conspicuous gland at the fork of the midrib. Corner (l. c.) reports that the plant is exceedingly variable in leaf-form, the seedlings and some varieties of full-grown plants having pointed leaves. Corner further states that the mountain form has smaller fruits while the seashore form has larger fruits; this is true also with the Philippine specimens, our mountain form has much smaller fruits (4 to 5 millimeters in diameter). In habit the plant is also variable, generally an epiphyte but occurring also as a terrestrial bush on sandy shores and on mountain tops and in bogs.

ANONACEÆ

Genus GONIOTHALAMUS Blume

GONIOTHALAMUS CATANDUANENSIS Quis. sp. nov.

Arbuscula 2–4 m alta floribus exceptis glabra; foliis oblongis, rarissime oblongo-oblanceolatis, 28–38.5 cm longis, 11–18.5 cm latis, basi subacutis vel acutis, apice brevissime abrupte acuminatis; nervis lateralibus utrinque 14–18, subtus prominentibus, anastomosantibus; inflorescentiis trunci- vel rami-floris; floribus solitariis vel fasciculatis, pedicellatis; sepalis 3, triangulari-ovatis, acutis, 4–7 mm longis, extus sparse pubescentibus; petalis exterioribus ovato-lanceolatis, acuminatis, 2.5–3.5 cm longis, 1.4–2 cm latis, pubescentibus; petalis interioribus ovatis, acutis, 8–9.5 mm longis; densissime pubescentibus; staminibus numerosis, 2–2.5 mm longis; carpellis numerosis, 4–4.5 mm longis, cylindraceis, stylis simplicibus, ad basi pubescentibus et curvatis; fructibus oblongis, 1.7–2.3 cm longis, 1.3–1.4 cm diametro, glabris.

A shrub 2 to 4 m high, glabrous throughout except the flowers; trunk terete, dark brown; branches terete, slender, brownish gray when dry. Leaves large, oblong, very rarely oblong-oblanceolate, 28 to 38.5 cm long, 11 to 18.5 cm wide, subcoriaceous, the base subacute or acute, the apex shortly and abruptly acuminate; lateral nerves 14 to 18 on each side of the midrib, prominent beneath, anastomosing, the reticulations somewhat prominent; petioles 1.5 to 2.5 cm long. Flowers white (Ramos & Edaño), from tubercles of the slender trunk and branches, solitary or fascicled, their pedicels slender, 1.3 to 1.5 cm long. Sepals 3, valvate, lobes ovate, acute, 4 to 7 mm long, sparsely pubescent. Petals 6, the outer three ovate-lanceolate, 2.5 to 3.5 cm long, 1.4 to 2 cm wide, acuminate, pubescent; the three inner cohering over the stamens and carpels, ovate, acute, 8 to 9.5 mm long, densely pubescent on the outside. Stamens numerous, 2 to 2.5 mm long, the connectives elongated; carpels numerous, 4 to 4.5 mm long, cylindric, the style simple, but the base curved and pubescent. Fruits oblong, 1.6 to 2.3 cm long, 1.3 to 1.4 cm in diameter, dark brown, glabrous; the peduncles 2 to 2.5 cm long, slender.

CATANDUANES, Albay Province, Simamla, *Bur. Sci. 75183 Ramos & Edaño* (type), August 8, 1928, at low altitudes; Dukulangpatag, *Bur. Sci. 75590 Ramos & Edaño,* August 20, 1928, along forested streams, altitude about 700 m. LUZON, Camarines Sur Province, Mt. Potianai, *Bur. Sci. 75937 Edaño,* November 5, 1928, on forested slopes, altitude about 900 m;

Agosais, *Bur. Sci. 76135 Edaño,* October 24, 1928, along streams in forests, altitude about 500 m.

A species in vegetative characters, particularly in its large leaves, somewhat resembling *G. gigantifolius* Merr. and *G. suluensis* Merr., but differing radically in its floral details and fructification. It differs from *G. suluensis* Merr. in having smaller leaves and flowers and in the details of its floral parts; and from *G. gigantifolius* Merr. radically in the shape and size of the fruits, and in its leaves having fewer lateral nerves.

Genus DREPANANTHUS Maingay

DREPANANTHUS CONVOCARII Quis. sp. nov.

Arbor circiter 7 m alta fructibus exceptis glabra; foliis oblongis, 33–42 cm longis, 13.5–19.5 cm latis, basi acutis, apice abrupte breviter acuminatis; nervis lateralibus utrinque 14–15; fructibus ellipsoideis, 1–1.9 cm longis, 1–1.2 cm diametro, glabris.

A small tree about 7 m high, pubescent throughout except the mature fruits; branches dark brown, rusty pubescent. Leaves large, oblong, 33 to 42 cm long, 13.5 to 19.5 cm wide, subcoriaceous, the base acute, the apex shortly acuminate; lateral nerves 14 to 15 on each side of the midrib, prominent; the young leaves very densely pubescent on both surfaces, becoming glabrous on the upper surface in the mature leaves; petioles densely pubescent, 2 to 2.8 cm long. Flowers unknown. Fruits many, ellipsoid, borne on branches, 1 to 1.9 cm long, 1 to 1.2 cm in diameter, glabrous, black.

MINDANAO, Agusan Province, Asiga River, *Bur. Sci. 84112 Ramos & Convocar,* April 23, 1931, in damp forests, altitude about 1,000 m.

D. Convocarii is apparently somewhat allied to *D. apoensis* Elm., from which it is readily distinguished by its larger, oblong leaves. This species is named in honor of Mr. Pascual Convocar, a collector of the Philippine National Herbarium.

LAURACEÆ

Genus CINNAMOMUM Blume

CINNAMOMUM OROI Quis. sp. nov.

Arbor circiter 15 m alta, ramulis et subtus foliis et inflorescentiis dense molliter griseo-pubescentibus; foliis coriaceis, oblongo-ellipticis, ad 12.5 cm longis, et 5.5 cm latis, supra nitidis, apice acutis, basi acutis, valde 3-plinerviis; paniculis terminalibus, laxifloris, 12–18 cm longis; floribus pedicellatis, circiter 3 mm longis; staminibus 2–2.25 mm longis, filamentis quam

antheris duplo longioribus, pubescentibus; staminoidiis stipitatis, 1.4–1.5 mm longis, pubescentibus; ovario glabro, obovoideo.

A tree about 15 m high (Oro) ; branches, lower surfaces of the leaves, and the inflorescence densely and softly gray-pubescent. Leaves opposite or subopposite, coriaceous, oblong-elliptic, 10 to 12.5 cm long, 3 to 5.5 cm wide, apex acute, base acute, the upper surface very smooth and shining, the lower dull, prominently 3-plinerved; petioles 8 to 12 mm long, densely pubescent when young, in age glabrescent. Panicles in the upper axils, laxly flowered, 12 to 18 cm long, densely and softly gray-pubescent. Buds obovoid. Flowers about 3 mm long, externally densely pubescent, the pedicels very slender; the perianth lobes oblong-obovate, obtuse. Stamens 2 to 2.25 mm long, the filaments pubescent, about twice as long as the anthers. Staminodes stipitate, 1.4 to 1.5 mm long, pubescent. Ovary glabrous, obovoid; the style as long as the ovary.

LUZON, Tayabas Province, Kagascas, *For. Bur. 30880 Oro,* April 1, 1929, on forested slopes, altitude about 300 m.

In vegetative characters approaching those of *C. Sandkuhlii* Merr. differing, however, in having smaller leaves, shorter inflorescences, more slender peduncles, smaller flowers and obovoid ovaries. Further, *C. Sandkuhlii* is a high altitude form, while this species is a low altitude one. The species is named in honor of Mr. M. Oro, forester and an active collector of the Philippine Bureau of Forestry.

Genus LITSEA Lamarck

LITSEA DIOSPYRIFOLIA Quis. sp. nov.

Arbor glabra, 5-8 m alta; ramulis, petiolis et nervis in sicco nigrescentibus; foliis alternis, oblongis, vel oblongo-ellipticis, coriaceis, ad 10.6 cm longis, et 6.2 cm latis, basi acutis vel subacutis, apice obtusis vel rarissime rotundatis, supra nitidis, nervis utrinque 7 vel 8, reticulis gracilibus, obscuris; fructibus nigrescentibus, globosis, glabris, 1.3-1.5 cm diametro, calycibus accrescentibus, hypocrateriformibus, circiter 1 cm diametro.

A glabrous tree, 5 to 8 m high (Edaño). Branches terete, grayish brown to brown; the branchlets distinctly black when dry. Leaves alternate, oblong to oblong-elliptic, coriaceous, 6 to 10.6 cm long, 3 to 6.2 cm wide, narrowed to the acute or subacute base, apex obtuse or very rarely rounded, olivaceous-brown to dark brown and shining on the upper surface, the lower surface paler and somewhat glaucous; lateral nerves 7 or 8 on each side of the midrib, prominently dark brown to black, the reticulations slender, obscure; petioles slender, black, 1.5 to

3 cm long. Fruits usually three developing from each very short peduncle, black, glabrous, globose, 1.3 to 1.5 cm in diameter, the accrescent calyx salver-shaped, the tube subcylindric, stout, 5 to 6 mm long, the limb spreading, about 1 cm in diameter.

LUZON, Camarines Sur Province; Her-it River, *Bur. Sci. 76459 Edaño* (type), December 8, 1928, on forested slopes, altitude about 800 m; Mt. Isarog, *Bur. Sci. 76232 Edaño*, November 28, 1928, on forested slopes, altitude 1,300 m.

The leaf is unique in form and coloring, and without the fruits one might mistake it for a *Diospyros*. It is characterized by its small, oblong to oblong-elliptic, glabrous leaves and large, black, globose, glabrous fruits.

BURSERACEÆ

Genus HEMISANTIRIA H. J. Lam

The genus *Hemisantiria* was proposed by Lam in 1929 for certain species of *Santiria* and *Canarium* which do not properly belong to these two genera.

According to Lam, *Hemisantiria* is a genus between *Canarium* and *Santiria;* although with rather vague limits. He thinks its separation necessary to contain some twelve or thirteen species, most of which were formerly placed in *Canarium* but which are distinctly different from the type of that genus in the characters of the leaves, flowers, and especially the fruits. From *Santiria* it may be distinguished by the ovoid, not or hardly zygomorphous fruits, the nearly apical style, and the nearly always unisexual flowers.

Below is given the only Philippine species described under *Santiria,* which is referable to *Hemisantiria.*

HEMISANTIRIA NITIDA (Merr.) H. J. Lam.

Hemisantiria nitida (Merr.) H. J. LAM in Merr. Univ. California Publ. Bot. 15 (1929) 118.

Santiria nitida MERR. in Govt. Lab. Publ. (Philip.) 35 (1905) 29, Philip. Journ. Sci. 1 (1906) Suppl. 71, Enum. Philip. Fl. Pl. 2 (1923) 356.

EUPHORBIACEÆ

Genus CLAOXYLON Jussieu

CLAOXYLON PUBESCENS Quis. sp. nov.

Frutex 1-2 m altus; ramulis, foliis infructescentiisque dense pubescentibus; foliis viridibus, ellipticis vel lanceolato-ellipticis, chartaceis ad 20 cm longis, et 8 cm latis, basi acutis vel subacutis, apice abrupte acuminatis, nervis utrinque 5 vel 6, margine

minute glanduloso-denticulatis vel dentatis; petiolis ad 10.5 cm longis; flores ♂ et ♀ ignoti; infructescentiis brevibus, ad 4 cm longis; capsula subglobosa, densissime pubescente, 1.2–1.5 cm diametro, 3-loculari; seminibus globosis, glabris, rugosis, 4-5 mm diametro.

A shrub 1 to 2 m tall, the branchlets, leaves, and infructescences densely pubescent. Leaves greenish, elliptic to lanceolate-elliptic, chartaceous, 10 to 20 cm long, 4.5 to 8 cm wide, base acute or subacute, the apex rather abruptly acuminate, margins minutely glandular-denticulate or dentate, densely pubescent on both surfaces, particularly the midrib and lateral nerves beneath; lateral nerves 5 or 6 on each side of the midrib, curved-ascending, arched-anastomosing, prominent; petioles densely pubescent, 2.5 to 10.5 cm long. Staminate and pistillate flowers not seen. Infructescences abbreviated, up to 4 cm in length, in some cases almost sessile. Capsules subglobose, very densely pubescent, 1.2 to 1.5 cm in diameter, 3-celled; the peduncles up to 4 mm long. Seeds globose, glabrous, rugose, 4 to 5 mm in diameter.

LUZON, Camarines Sur Province, Paganan River, *Bur. Sci. 76416 Edaño* (type), December 1, 1928, along streams, altitude about 900 m; Her-it River, *Bur. Sci. 76455 Edaño,* December 6 1928, on forested slopes, altitude about 900 m; Agosais, *Bur. Sci. 76119 Edaño,* October 24, 1928, in damp forests, altitude about 500 m; Adiagnao, *Bur. Sci. 6379 Robinson,* August 29, 1908. CATANDUANES, Dakulangpatag, *Bur. Sci. 75376 Ramos & Edaño,* August 24, 1928, along streams in forests, altitude about 700 m.

A species entirely distinct from all previously described Philippine forms, apparently allied to *C. subviride* Elm. It is readily distinguished by its very pubescent branchlets, leaves, petioles, and capsules. The hairs on the capsules are long and rather stiff.

ANACARDIACEÆ

Genus SEMECARPUS Linnæus f.

SEMECARPUS OBLONGIFOLIA Quis. sp. nov.

Affinis *S. lanceolata* Merr. Arbor glabra, 8–15 m alta; foliis coriaceis, oblongis vel oblongo-ellipticis, ad 18 cm longis et 6 cm latis, basi acutis, apice abrupte acuminatis, nervis utrinque circiter 10 prominentibus, supra nitidis, subtus in sicco pallidioribus, reticulis prominentibus; petiolis ad 5.5 cm longis; paniculis glabris, ad 22 cm longis; drupis reniformibus, compressis, breviter carinatis, 1.5-1.7 cm latis.

A tree 8 to 15 m high, glabrous. Branches slender, the ultimate ones about 5 mm in diameter, grayish brown. Leaves

oblong or oblong-elliptic, 9 to 18 cm long, 3 to 6 cm wide, base acute, apex abruptly acuminate, the acumen obtuse, coriaceous, shining on the upper surface, paler on the lower when dry; lateral nerves about 10 on each side of the midrib, prominent, spreading, faintly anastomosing, the reticulations on both surfaces distinct; petioles 2.5 to 5.5 cm long. Inflorescences and flowers not seen. Fruiting panicles terminal, glabrous, up to 22 cm long. Torus when dry 8 to 10 mm long, 6 to 7 mm wide at the tip, narrowed below; the peduncle as long as the torus. Drupe reniform, compressed, 1.5 to 1.7 cm wide, 1.3 to 1.4 cm wide, somewhat keeled.

LUZON, Tayabas Province, Guinayangan, Barrio Malbog, *For. Bur. 30688 Oro* (type), January 23, 1929, on forested slopes, altitude about 80 m; *For. Bur. 30641 Ladia,* January 20, 1929, on a ridge, altitude about 200 m.

Apparently allied to *S. lanceolata* Merr. differing in its oblong or oblong-elliptic, abruptly acuminate leaves. Further, the lateral nerves are quite prominent and fewer in number (about 10), and the branchlets are decidedly more slender.

SAPINDACEÆ

Genus ALLOPHYLUS Linnæus

ALLOPHYLUS SIMPLEX Quis. sp. nov.

Frutex 1 m altus; foliis unifoliolatis, oblanceolatis vel oblongo-ellipticis, 19–23.5 cm longis, 5.5–7 cm latis, utrinque glabris, chartaceis, basi acutis, apice perspicue acuminatis, ex margine ad apicem irregulariter lobato-serratis, dentibus acutis; petiolo glabro, 1.5–2.5 cm longo. Inflorescentiis axillaribus, simplicibus, tenuibus, brevibus, 3–5 cm longis; pedunculo 0.5–1 cm longo; sepalis 4, extus glabris, margine obscure pubescentibus; petalis 4, villosis.

An undershrub 1 meter in height (Merrill); stem terete, glabrous, unbranched, lenticellate, young grayish or grayish brown at the base. Leaves 1-foliolate, oblanceolate or oblong-elliptic, 19 to 23.5 cm long, 5.5 to 7 cm wide, chartaceous, glabrous on both surfaces, the upper surface brownish-olivaceous, the lower paler, equally or subequally narrowed to the acute base, the apex prominently acuminate, the margins at the base usually entire, towards the apex irregularly lobe-toothed, sinuses broad and shallow, the teeth short and acute and less than 1 cm long; midrib, nerves and reticulations brownish; the lateral nerves about 10 on each side of the midrib; petioles glabrous,

slender, short, 1.5 to 2.5 cm long. Inflorescences axillary, very slender, 3 to 5 cm long; peduncles somewhat pubescent, very short, 0.5–1 cm long. Flowers minute, white (Merrill), their pedicels 1 to 1.25 mm long. Sepals 4, glabrous without, their margins obscurely pubescent, concave, imbricate, suborbicular, 1.5 to 2 mm long. Petals 4, subtruncate, narrowed below, about 1 mm long, densely villose. Stamens 8, in center of flower; filaments villose, 0.5 to 0.75 mm long; anthers suborbicular-elliptic, 0.4 to 0.5 mm in diameter; cells contiguous, parallel.

PALAWAN, Malampaya Bay, *Merrill 7262* (type), September 18, 1910, in forests at low altitudes; same locality, *Merrill 11576*, in primary forests, at low altitudes, October 8, 1922. BALABAC, Palawan Province, *Bur. Sci. 49706 Ramos & Edaño*, November 22, 1922.

Belonging to the group of 1-foliolate *Allophylus*, and closely related to *A. simplicifolius* Radlk. differing conspicuously in its very short slender inflorescences, shorter petioles; and margins of the leaves, which are usually entire at the base, irregularly lobe-toothed towards the apex, the sinuses broad and shallow, and the teeth short and acute.

VITACEÆ

Genus CAYRATIA Jussieu

In accordance with action taken by the Botanical International Congress, the genus *Cayratia* of Jussieu is conserved in preference to *Columella* of Loureiro. This is frankly desirable because of possible confusion of *Columella* Lour. (1790) with *Columellia* Ruiz & Pav. (1794), the latter typifying the family Columelliaceæ. Merrill notes, however, that *Lagenula* Lour. 1790 is also synonymous with *Columella* Lour. and *Cayratia* Juss. [Trans. Am. Philos. Soc. II 24^2 (1835) 255] but now that *Cayratia* Juss. has been conserved, *Lagenula* Lour. cannot replace it. This action necessitates some changes in nomenclature in relation to the Philippine species of the genus.

CAYRATIA APOENSIS (Elm.) Quis. comb. nov.

Columella apoensis (Elm.) MERR. in Enum. Phil. Fl. Pl. 3 (1923) 8.
Cissus apoensis ELM., Leafl. Bot. 8 (1915) 2880.

CAYRATIA CORNICULATA (Benth.) Gagnep.

Columella corniculata (Benth.) MERR. in Philip. Journ. Sci. 11 (1916) Bot. 133, Enum. Philip. Fl. Pl. 3 (1923) 8.
Vitis corniculata BENTH., Fl. Hongkong (1861) 54.
Cissus corniculata PLANCH. in DC. Monog. Phan. 5 (1887) 563.

Cayratia corniculata GAGNEP. in Not. Syst. 1 (1911) 347.

Cayratia japonica GAGNEP. in Not. Syst. 1 (1911) 349, quoad Philip.; MERR. in Philip. Journ. Sci. 1 (1906) Suppl. 89, non *Vitis japonica* Willd.

CAYRATIA GENICULATA (Blume) Gagnep.

Cissus geniculata BLUME, Bidjr. (1825) 184; A. GRAY, Bot. Wilkes U. S. Explor. Exped. (1854) 272; PLANCH. in DC. Monog. Phan. 5 (1887) 572.

Vitis geniculata MIQ., Ann. Mus. Bot. Ludg.-Bat. 1 (1863) 81; F.-VILL., Novis. App. (1880) 49.

Cissus rubescens BLANCO, Fl. Filip. (1837) 71.

Cissus alata BLANCO, Fl. Filip. ed. 2 (1845) 51, ed. 3 1 (1877) 95, non Jacq.

Cayratia geniculata GAGNEP. in Not. Syst. 1 (1911) 345.

Columella geniculata (Blume) MERR. in Philip. Journ. Sci. 11 (1916) Bot. 132, Sp. Blancoanae (1918) 246, Enum. Philip. Fl. Pl. 3 (1923) 8.

var. SARCOCARPA (Merr.) Quis. comb. nov.

Columella geniculata (Blume) MERR. var. *sarcocarpa* MERR. in Philip. Journ. Sci. 11 (1916) Bot. 133, Enum. Philip. Fl. Pl. 3 (1923) 8.

CAYRATIA MOLLISSIMA (Wall.) Gagnep.

Vitis mollissima WALL., Fl. Ind. ed. 2 2 (1832) 482; LAWS in Hook. f. Fl. Brit. Ind. 1 (1875) 656; PLANCH. in DC. Monog. Phan. 5 (1887) 575.

Cissus mollissima PLANCH. in DC. Monog. Phan. 5 (1887) 575.

Cayratia mollissima GAGNEP. in Not. Syst. 1 (1911) 345.

Columella mollisima (Wall.) MERR. in Enum. Philip. Fl. Pl. 3 (1923) 8.

CAYRATIA PEDATA (Lam.) Juss.

Cissus pedata LAM., Encycl. 1 (1783) 31; PLANCH. in DC. Monog. Phan. 5 (1877) 558.

Columella pedata LOUR., Fl. Cochinch. (1790) 85; MERR. in Philip. Journ. Sci. 11 (1916) Bot. 134, Enum. Philip. Fl. 3 (1923) 9.

Cayratia pedata JUSS., Dict. Class. Hist. Nat. 4 (1823) 136; GAGNEP. in Not. Syst. 1 (1911) 346.

Vitis pedata VAHL ex WALL. Cat. (1832) No. 6027; LAWS in Hook. f. Fl. Brit. Ind. 1 (1875) 661; F.-VILL., Novis. App. Fl. Filip. (1880) 50.

CAYRATIA PTERITA (Merr.) Quis. comb. nov.

Columella pterita MERR. in Philip. Journ. Sci. 11 (1916) Bot. 135, Enum. Philip. Fl. Pl. 3 (1923) 9.

CAYRATIA SIMPLICIFOLIA (Merr.) Quis. comb. nov.

Columella simplicifolia MERR. in Philip. Jorun. Sci. 11 (1916) Bot. 135, Enum. Philip. Fl. Pl. 3 (1923) 9.

CAYRATIA TENUIFOLIA (Heyne) Gagnep.

Cissus tenuifolia HEYNE in Wall. Cat. (1831) No. 6022; PLANCH. in DC. Monog. Phan. 5 (1887) 563.

Vitis tenuifolia W. & A., Prodr. (1834) 129.

Cayratia tenuifolia GAGNEP. in Not. Syst. 1 (1911) 348.
Columella tenuifolia (Heyne) MERR. in Philip. Jorun. Sci. 11 (1916) Bot. 134, Enum. Philip. Fl. Pl. 3 (1923) 9.

CAYRATIA TRIFOLIA (Linn.) Quis. comb. nov.

Vitis trifolia LINN., Sp. Pl. (1753) 293.
Cissus carnosa LAM., Encycl. 1 (1783) 31; PLANCH. in DC. Monog. Phan. 5 (1887) 570.
Cissus acida BLANCO, Fl. Filip. (1837) 69, ed. 2 (1845) 50, ed. 3 1 (1877) 94, *t. 24*, non Linn.
Vitis carnosa WALL., Cat. (1831) No. 6081; LAWS. in Hook. f. Fl. Brit. Ind. 1 (1875) 654; F.-VILL., Novis. App. (1880) 49; VIDAL, Sinopsis Atlas (1883) 21, *t. 33, f. A.*
Cissus trifolia K. SCHUM., Fl. Kaiser Willhelmsl. (1889) 71; MERR., Fl. Manila (1912) 211.

var. CINEREA (Lam.) Quis. comb. nov.

Cissus cinerea LAM., Tabl. Encycl. 1 (1791) 332.
Columella trifolia (Linn.) MERR. var. *cinerea* (Lam.) MERR., Enum. Philip. Fl. Pl. 3 (1923) 10.

Genus LEEA Royen

LEEA CATANDUANENSIS Quis. sp. nov.

Frutex 1–2 m altus, glaber; ramis canaliculatis; foliis unifoliolatis, oblanceolatis, ad 50 cm longis, et 19.5 cm latis, chartaceis, apice acutis, basi obtusis, margine dentatis, nervis lateralibus utrinque 19–20, subtus perspicuis; petiolo ad 9 cm longo; infructescentiis in axillis superioribus, circiter 8 cm longis; fructibus nigrescentibus, nitidis, triangularibus vel quadratis, supra compressis, circiter 8–10 mm latis, seminibus 3 vel 4.

A shrub 1 to 2 m high, glabrous throughout; branches and branchlets deeply furrowed, dark brown when dry, the ultimate branchlets 8 to 10 mm in diameter. Leaves simple, oblanceolate, 45 to 50 cm long, 18 to 19.5 cm wide, chartaceous, narrowed to the acute apex, the base narrowed obtuse, margins somewhat regularly dentate, the upper surface dark brown when dry, the lower paler; lateral nerves 19 to 20 on each side of the midrib, prominent, ascending, the reticulations distinct; petioles furrowed, not winged, 8 to 9 cm long. Infructescences in the upper axils, about 8 cm long, sparingly branched. Fruits triangular or quadrate, (depressed on top), 8 to 10 mm wide, smooth, black when dry, each with 3 or 4 seeds.

CATANDUANES, Virac, *Bur. Sci. 75429 Ramos & Edaño*, August 1, 1928, in damp forests, at low altitude.

This species belongs in the group of species with simple leaves (*L. banahaensis* Elm., *L. pycnantha* Quis. & Merr., and *L. mag-*

nifolia Merr.), and is most closely allied to *L. magnifolia* Merr. from which it is readily distinguished by its smaller and oblanceolate, acute leaves, and the wingless petioles.

DILLENIACEÆ

Genus SAURAUIA Willdenow

SAURAUIA CORDATA Quis sp. nov.

Frutex circiter 2 m altus, ramulis junioribus inflorescentiisque adpresse breviter setosis; foliis ovatis vel oblongo-ovatis, 16.5–23 cm longis, 8–11 cm latis, subcoriaceis, basi cordatis, apice breviter acuminatis, margine minute denticulatis, nervis utrinque 12 vel 13 perspicuis, supra, costam nervisque perspicue adpresse breviter setosis exceptis glabris, subtus dense pubescentibus; petiolo 2.5–4.5 cm longo; inflorescentiis axillaribus, 2–3 cm longis, breviter pedunculatis, solitariis vel fasciculatis, 1–4 floris; floribus 5.5–6 mm longis; pedicellis gracilibus, 7–9 mm longis; sepalis subaequalibus, oblongis, obtusis, 4.5–5.5 mm longis, 2.5–3.5 mm latis, leviter cucullatis, breviter adpresse setosis; corolla ignota; staminibus ignotis; ovario subgloboso, breviter piloso; stylis 3, basi unitis; fructibus subglobosis, circiter 4.5 mm diametro; seminibus minutis, numerosis.

A shrub about 2 m high, the younger branches and inflorescences appressed-setose, the setae very short. Leaves ovate or oblong-ovate, 16.5 to 23 cm long, 8 to 11 cm wide, subcoriaceous, base cordate, apex shortly acuminate, at maturity the upper surface glabrous except the midrib and nerves, the lower surface densely shortly appressed-setose, the margins minutely denticulate; lateral nerves 12 or 13, prominent, anastomosing; petioles densely pubescent, 2.5 to 4.5 cm long. Inflorescences axillary, solitary or fascicled, 2 to 3 cm long, 1- to 4-flowered, the peduncles very slender, short. Flowers evidently pistillate only, 5.5 to 6 mm long, their pedicels very slender, densely pubescent, 7 to 9 mm long, each with minute bracteoles. Sepals subequal, oblong, obtuse, 4.5 to 5.5 mm long, 2.5 to 3.5 mm wide, slightly cucullate, shortly appressed-setose. Petals not seen. Stamens not seen. Ovary subglobose, slightly pilose; styles 3, united at the base, the arms 2 to 3 mm long. Fruits capsular, about 4.5 mm in diameter, glabrous; seeds numerous, minute.

CATANDUANES, Mt. Abucay, *Bur. Sci. 75267 Ramos & Edaño*, September 9, 1928, on damp forests, altitude about 1,300 m.

A very characteristic species distinguished by its ovate or oblong-ovate leaves which are cordate at the base.

SAURAUIA GIGANTIFOLIA Quis. sp. nov.

Frutex circiter 3 m altus; truncis junioribus petiolisque valde setosis, setis ad 7 mm longis; foliis magnis, late oblanceolatis, 24.5–33.5 cm longis, 13.5–20 cm latis, apice mucronatis vel brevissime acuminatis, basi attenuatis, obtusis; nervis utrinque 13 vel 14, utrinque costa nervisque exceptis parcissime setosis glabris; petiolo 1.5–2.5 cm longo, valde setoso; inflorescentiis caulinis, numerosis, fasciculatis, 2–4 cm longis; bracteis ovatis, acutis, 6.5–11 mm longis, 4–9 mm latis, glabris, margine plus minusve setosis; pedunculis glabris; sepalis late ovatis, subacutis vel obtusis, glabris, 7–9 mm longis, 6–10 mm latis, margine minute setosis; petalis glabris, oblongis, retusis, 10–12.5 mm longis, 7.5–9.5 mm latis; staminibus numerosis, glabris, 4–4.5 mm longis; ovario glabro, subgloboso; stylis 4, gracilibus, 4–4.5 mm longis, ad basim connatis.

A shrub about 3 m high, glabrous except the growing tips of stems and petioles which are very conspicuously clothed with long setae. The young stems stout, much wrinkled when dry, about 1 cm in diameter, the growing tips very densely and conspicuously long-setose. Leaves large, broadly oblanceolate, 24.5 to 33.5 cm long, 13.5 to 20 cm wide, subcoriaceous, glabrous on both surfaces, except the midrib and lateral nerves which are sparsely setose, narrowed to the obtuse base, the apex mucronate or very shortly acuminate, margins closely and minutely setose. Inflorescences from the trunk, few-flowered, numerous, fascicled, 2 to 4 cm long; the bracts somewhat cucullate, ovate, acute, 6.5 to 11 mm long, 4 to 9 mm wide (when flattened), glabrous except for the very few short setae on the margins, 1 to 2 cm long. Flowers white (Ramos & Edaño), about 2 cm across, the pedicels slender, glabrous, the bracteoles of the same shape as the bracts but smaller, in pairs at the base of the pedicels; sepals 5, subequal, broadly ovate, subacute or obtuse, 7 to 9 mm long, 6 to 10 mm wide, glabrous except the setose margins; petals 5, subequal, glabrous, oblong, retuse, 10 to 12.5 mm long, 7.5 to 9.5 mm wide, the lobes subequal; stamens numerous, glabrous, 4 to 4.5 mm long, the anthers appendiculate, as long as the filaments; ovary subglobose, glabrous, the styles 4, slender, united at the base, the arms 4 to 4.5 mm long.

MINDANAO, Agusan Province, Mt. Diuata, *Bur. Sci. 83716 Ramos & Convocar,* April 10, 1931, on forested slopes, altitude about 1,000 m.

A species in the group with cauline inflorescences, closely allied to *S. ampla* Merr. but differing in its broadly oblanceolate

leaves, shorter inflorescences, and the presence of many conspicuous bracts. The growing tips of the stems and the petioles, clothed with unusually long and very prominent setae, are important distinguishing features of this species.

SAURAUIA KNEMAEFOLIA Quis. sp. nov.

Frutex circiter 2 m altus, truncis junioribus, petiolis, foliis subtus et inflorescentiis densissime cinnamomeo-pubescentibus, vix setosis; foliis oblongis vel oblongo-ellipticis, 22–39 cm longis, 8–10 cm latis, subcoriaceis, utrinque acutis, margine perspicue subglanduloso-denticulatis; nervis utrinque 27–32, perpicuis; inflorescentiis axillaribus, 5–8 cm longis, paucifloris; floribus magnis, circiter 3 cm diametro; sepalis subequalibus, extus pubescentibus, suborbicularibus, rotundatis, 1.3–1.8 cm longis, 1.2–1.8 cm latis; petalis oblongis, retusis, glabris, 1.4–1.5 cm longis, 1–1.2 cm latis; ovario subgloboso, dense pubescente, stylis 5, glabris, 7–8 mm longis, ad basim connatis; staminibus glabris, numerosis, 4–5 mm longis.

A shrub about 2 m high, the young stems, petioles, the lower surface of the leaves, and inflorescences very densely cinnamomeo-pubescent, the indumentum felted, not setose. Branches terete, reddish brown, becoming glabrous with age, the young branches and petioles with few, scattered appressed scales. Leaves oblong to oblong-elliptic, 22 to 39 cm long, 8 to 10 cm wide, subcoriaceous, narrowed at both ends, acute, the margins, except near the base, conspicuously denticulate with glandlike teeth about 1 mm in length, the upper surface smooth, glabrous, and dark brown, the lower surface much paler; lateral nerves 27 to 32 on each side of the midrib, prominent, ascending, the reticulations slender and obscure; petioles 1.7 to 2 cm long, the younger ones densely cinnamomeo-pubescent, the older ones glabrous. Inflorescences axillary, few-flowered, never 1-flowered, 5 to 8 cm long, longer than the petioles; the bracts oblong-elliptic, narrowed at both ends, acute, up to 2 cm long, the bracteoles smaller, up to 1 cm long, 0.5 cm wide. Flowers white (Edaño), large, about 3 cm in diameter; sepals subequal, cinnamomeo-pubescent without, suborbicular, rounded, 1.3 to 1.8 cm long, 1.2 to 1.8 cm wide; petals white, glabrous, oblong, retuse, 1.4 to 1.5 cm long, 1.0 to 1.2 cm wide; ovary subglobose, very densely cinnamomeo-pubescent, becoming glabrous with age, styles 5, glabrous, the arms 7 to 8 mm long, united at the base; stamens glabrous, numerous, 4 to 5 mm long.

PALAWAN, Mt. Manalsal, *Bur. Sci. 77764 Edaño*, May 13, 1929, on forested slopes, altitude about 1,200 m.

A unique species, in its indumentum similar to *S. bicolor* Merr. and perhaps allied to it, differing however, in its larger, oblong to oblong-elliptic leaves with numerous (27 to 32) lateral nerves, longer and larger inflorescences and larger flowers, and in having five styles. When dry, the leaves remind one of those of some species of *Knema*.

SAURAUIA RAMOSII Quis. sp. nov.

Frutex circiter 2 m altus, ramulis junioribus inflorescentiisque parcissime breviter adpresse furfuraceo-setosis; foliis oblanceolatis vel elliptico-oblanceolatis, ad 20 cm longis et 7.5 cm latis, costa nervisque sparsissime et parcissime breviter adpresse furfuraceo-setosis, exceptis glabris, apice breviter acuminatis vel raro acutis, basi attenuatis, subacutis vel obtusis; nervis utrinque 8–10, obscuris; bracteis suborbicularibus, subacutis vel obtusis, 1.0–1.5 cm longis, 1.0–1.3 cm latis, glabris; inflorescentiis axillaribus, paucifloris, 4–8 cm longis; pedunculis sparse pubescentibus, gracilibus, 3.5–6.5 cm longis; floris circiter 1.5 cm diametro; sepalis extus parcissime breviter adpresse furfuraceo-setosis, subequalibus, anguste oblongis vel late ovatis, obtusis, circiter 6 mm longis, 3–5.5 mm latis; petalis oblongis, retusis, glabris, 8–9 mm longis, 4–5 mm latis; ovario glabro, ovoideo; stylis 3, circiter 4 mm longis, ad basim connatis; staminibus numerosis.

A shrub about 2 m high, the young branchlets densely covered with short closely appressed scalelike setae. Branches terete, reddish brown. Leaves subcoriaceous, oblanceolate to elliptic-oblanceolate, 10 to 20 cm long, 4 to 7.5 cm wide, glabrous on both surfaces except the midrib and lateral nerves which bear few scattered short appressed scalelike setae, the apex shortly acuminate or rarely acute, narrowed below to the subacute or obtuse base, the margins irregularly glandular-denticulate, the glands less than 0.5 mm in length, the upper surface atro-olivaceous, the lower surface brown; lateral nerves 8 to 10 on each side of the midrib, obscure, the reticulations very obscure; petioles 1.5 to 4.8 cm long, with few scattered appressed scalelike setae, the older ones becoming glabrous. Inflorescences axillary, few-flowered, 4 to 8 cm long; the peduncles slender, sparsely pubescent, 3.5 to 6.5 cm long; the bracts suborbicular, subacute or obtuse, 1.0 to 1.5 cm long, 1.0 to 1.3 cm wide, gla-

brous. Flowers white (Ramos and Edaño), about 1.5 cm in diameter, the pedicels very slender, 5 to 6 mm long, with few scattered short appressed scalelike setae, the bracteoles smaller than the bracts, otherwise similar in shape, pubescent. Sepals 5, subequal, the two outer broadly ovate, obtuse, about 6 mm long, 5 to 5.5 mm wide, with few appressed scalelike setae on the outside, the three inner narrowly oblong, obtuse, about 6 mm long, 3 to 3.5 mm wide, thinner. Petals 5, oblong, retuse, 8 to 9 mm long, 4 to 5 mm wide, glabrous. Ovary glabrous, ovoid, styles 3, about 4 mm long, the arms as long as the united base. Stamens glabrous, numerous.

CATANDUANES, Mt. Abucay, *Bur. Sci. 75497 Ramos & Edaño,* September 9, 1928, in damp forests, altitude about 1,500 m.

Doubtless belonging in the *S. latibracteata* Choisy group, differing conspicuously from this species in its indumentum, shape and color of the leaves, and details of the inflorescences and flowers. Named in memory of Maximo Ramos, a great collector, who died on active duty while collecting in the wilds of Mt. Matutum, Cotabato, Mindanao.

MYRSINACEÆ

Genus LOHERIA Merrill

LOHERIA MAGNIFOLIA Quis. sp. nov.

Frutex erectus vix ramosus, inflorescentiis exceptis glaber; foliis coriaceis, permagnis, late oblanceolatis, 37–51 cm longis, 9.5–16.5 cm latis, breviter late acuminatis, acuminibus acutis ad obtusis, basi attenuatis, integris vel sursum denticulatis, subtus dense minute glandulosis, nervis primariis utrinque 17–24, valde perspicuis; inflorescentiis ♀ anguste paniculatis, pedunculatis, 6–8 cm longis, bracteis imbricatis, numerosis, oblongis, acutis, 2–5.5 cm longis; floribus confertis, 4-meris; sepalis triangulari-ovatis, acutis ad subacutis, 0.7–1 mm longis, puberulis, margine ciliolatis; petalis oblongo-ellipticis vel oblongo-ovatis, obtusis, 2–2.25 mm longis; ovario oblongo-ovoideo, glabro, circiter 2 mm longo; inflorescentiis floribusque ♂ more ♀; staminibus 4, filamentis quam antheris paullo longioribus; fructibus globosis, 5.5–6 mm diametro, glabris, perspicue apiculatis, longitudinaliter striatis.

An erect unbranched shrub about 1 m high, glabrous except the puberulent inflorescence. Stem brown, terete, woody, 1 to 1.7 cm in diameter at the summit. Leaves large, crowded at the apices of the stems, alternate, broadly oblanceolate, coria-

ceous, 37 to 51 cm long, 9.5 to 16.5 cm wide, entire throughout or obscurely repand-dentate near the apex, smooth and shining on both surfaces, glabrous, the apex very broadly and shortly acuminate, the acumen acute or blunt, gradually narrowed from the middle to the base, the lower surface very densely and minutely glandular-punctate; primary lateral nerves 17 to 24 on each side of the midrib, very prominent, ascending, anastomosing, the reticulations lax, distinct; petiole very stout, 1 cm or less or almost obsolete. Pistillate inflorescences crowded at the apex, axillary, narrowly paniculate, densely flowered, 6 to 8 cm long, the peduncles 2.5 to 3 cm long; the bracts oblong, acute, chartaceous, 2 to 5.5 cm long, brown, numerous, many-seriate, imbricate. Flowers 4-merous, subumbellately and racemosely disposed, the pedicels puberulent, rather stout, 0.75 to 1.5 mm long, the bracts lanceolate, acuminate, 1.5 to 2 mm long, the bracteoles smaller. Calyx 4-lobed, about 2 mm in diameter, the lobes triangular-ovate, acute to subacute, 0.7 to 1 mm long, 0.6 to 0.8 mm wide, spreading in anthesis, united for their lower one-half, puberulent, conspicuously glandular, the margins ciliolate. Petals 4, oblong-elliptic to oblong-ovate, obtuse, 2 to 2.25 mm long, about 1.5 mm wide, glabrous, conspicuously glandular, imbricate, reflexed in anthesis, united at the base, the tube up to 0.5 mm long. Staminodes 4, 1 to 1.25 mm long. Ovary oblong-ovoid, glabrous, about 2 mm long, stigma sessile. Staminate inflorescences similar to the female ones, puberulent, paniculate, numerous near the apices of the stems, 8.5 to 16 cm long, the branches numerous, up to 3 cm long, the bracts similar to those of the pistillate inflorescences. Staminate flowers 4-merous, numerous, racemosely diposed, the pedicels slender, densely puberulent, 1.5 to 2 mm long, the bracts, bracteoles, sepals, and petals similar to those of the pistillate flowers. Stamens 4, 1.75 to 2 mm long, the filaments slightly longer than the anthers which are triangular and somewhat sagittate at the base, acute. Ovary rudimentary, subulate, about 1.75 mm long. Fruits globose, 5.5 to 6 mm in diameter, glabrous, conspicuously apiculate, longitudinally striate, 1-seeded, albumen ruminate.

LUZON, Nueva Vizcaya Province, Mount Alzapan, *Bur. Sci. 45638* (type), *76569 Ramos & Edaño* (fruiting specimen), May 24, 1930 and May 30, 1930, respectively, on forested slopes, altitude about 1,700 meters or along forest streams at low altitudes: Rizal Province, without definite locality, *Loher 14871* (female plant).

A remarkable species, without doubt belonging to this genus, as characterized by E. D. Merrill, differing from *Loheria porteana* (Mez) Merr. in its very large, coriaceous, oblanceolate leaves.

FLACOURTIACEÆ

Genus CASEARIA Jacquin

CASEARIA HYDNOCARPOIDES Quis. sp. nov.

Frutex circiter 4 m altus, glaber; foliis integerrimis, oblongis vel oblongo-ovatis, ad 12.5 cm longis et 6 cm latis, utrinque nitidis, apice acutis, basi inaequilateralibus, acutis vel subacutis, nervis utrinque circiter 5, reticulis tenuibus distinctis; petiolo 7–9 mm longo; floribus axillaribus, fasciculatis, 5-meris, pedicellatis; staminibus 8, filamentis 1.5–1.75 mm longis; staminoidiis anguste oblongis, ciliatis; ovario ciliato.

Shrub about 4 m high, glabrous throughout except the flowers. Leaves entire, oblong or oblong-ovate, 11 to 12.5 cm long, 5 to 6 cm wide, apex acute, the base inequilaterally acute or subacute, chartaceous, olivaceous-brown, shining on both surfaces; lateral nerves about 5 on each side of the midrib; the reticulations on both surfaces slender and very distinct; petioles glabrous, 7 to 9 mm long. Flowers greenish white, fascicled; the pedicels glabrous, 2 to 3 mm long. Sepals 5, broadly ovate, obtuse, about 3 mm long, 2.5 to 3 mm wide, ciliate within. Fertile stamens 8, the glabrous filaments 1.5 to 1.75 mm long; staminodes alternating the stamens, shorter than the stamens, narrowly oblong, ciliate. Ovary ciliate at the base of the style.

PALAWAN, Taytay, *Merrill 9366*, May 9, 1913, on forested slopes, at low altitudes.

The species is well characterized by being entirely glabrous (except the flowers) with oblong or oblong-ovate, shining and reticulate leaves. It is allied to *C. trivalvis* (Blanco) Merr. differing in the shape and very prominent reticulate leaves and details of floral parts. The general appearance of the leaves, their texture, venation, etc. are strikingly like those of some species of *Hydnocarpus*.

CASEARIA WENZELII Merrill & Quisumbing sp. nov.

Arbor parva, partibus junioribus floribusque exceptis glabris; foliis chartaceis, magnis, oblongis, usque ad 23.5 cm longis et 10.8 cm latis, apice mucronatis, basi subacutis; nervis utrinque 9–10, supra obscuris; petiolo 8–10 mm longo; floribus axillaribus, fasciculatis, 5-meris, pedicellatis; staminibus 10, fila-

mentis ciliatis, 1.25–1.5 mm longis; staminoidiis anguste oblongis, ad apicem dense ciliatis, circiter 1.5 mm longis, 0.5 mm latis; ovario ovoideo, ciliato, stigmatibus capitatis.

A small tree, quite glabrous except the growing tips of the branchlets and leaves which are densely hirsute with very short hairs. Leaves large, chartaceous, oblong, 16.5 to 23.5 cm long, 10 to 10.8 cm wide, apex mucronate, base subacute, the margins entire, glabrous on both surfaces with age, the upper surface dark brown when dry, the lower paler; lateral nerves 9 to 10 on each side of the midrib, rather prominent on the lower surface, the upper obscure, the reticulations somewhat obscure; petioles glabrous, 8 to 10 mm long. Flowers axillary, numerous, fascicled. Pedicels very slender, ciliate, 1.25 to 1.5 mm long. Sepals 5, unequal (two flat and the three concave) oblong or broadly oblong, obtuse, on the outer surface ciliate, membranaceous, 4 to 4.5 mm long, 2.25 to 2.5 mm wide. Stamens 10, their filaments ciliate, united below with alternating staminodes, 1.25 to 1.5 mm long, twice as long as the anthers. Staminodes narrowly oblong, densely ciliate particularly at the apex, about 1.5 mm long, 0.5 mm wide. Ovary ovoid, ciliate; style very short; stigma capitate.

MINDANAO, Surigao Province, Surigao, *Wenzel 3026*, August 9, 1927.

Species belonging to *C. fuliginosa* Blanco group, differing conspicuously in its large, oblong, mucronate leaves.

SOME TREMATODE PARASITES OF FISHES IN THE COLLECTION OF THE UNIVERSITY OF THE PHILIPPINES

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TWO PLATES

Through the courtesy of Dr. Amado T. Feliciano, of the Department of Zoology, Junior College, University of the Philippines, we have been able to examine some trematode parasites of fishes collected by students majoring in ichthyology. Eight species have been identified, of which 3 appear to be new. We wish to record our thanks to Doctor Feliciano for placing the material at our disposal.

Family BUCEPHALIDÆ Poche, 1907

PROSORHYNCHUS TRIANGULARIS sp. nov. Plate 1, fig. 1.

A single specimen of this parasite is found in the collection.

Description.—Body elongated, 1.35 by 0.27 millimeters. Cuticle armed with numerous small spines. Rhynchus well developed, roughly triangular in outline, 0.20 by 0.14 millimeter. Pharynx equatorial, 0.06 millimeter in diameter; œsophagus short; intestine saccular, anterior to pharynx, 0.21 by 0.13 millimeter.

Testes globular, one immediately and obliquely behind the other; first testis 0.13 millimeter in diameter, on the left side of pharynx and partly overlapped by latter in ventral view; second testis 0.12 millimeter across, behind pharynx. Cirrus sac 0.35 by 0.07 millimeter, in posterior third of body length, about 0.14 millimeter from posterior extremity; incloses small, coiled vesicula seminalis and long straight cirrus, the greater length of which is surrounded by numerous prostatic cells. Genital pore median, ventral, about 0.10 millimeter from posterior end of body, leads to genital sinus.

Ovary subglobular, 0.08 millimeter in diameter, on right side of median line opposite anterior testis and partly overlapped in ventral view by antero-lateral border of pharynx. Oviduct

originates from posterior border of ovary. Shell gland and ootype complex lateral to pharynx, between ovary and second testis. Uterus confined in posterior region of body, behind testes. Vitellaria lateral, in roundish follicles, of which there are 15 on the left side (arranged in 5 groups of 3 each) and 13 on the right side; they extend from level of anterior border of intestine to level of posterior border of second testis. Eggs oval, slightly asymmetrical, yellowish, thick-shelled, operculated, 30 to 32 by 18.5 to 20 microns; some of them show at the abopercular end a filament similar to that described by Eckmann (1932) for the egg of *Prosorhynchus crucibulus.*

Excretory pore posteroterminal.

Host.—Glossogobius giurus.[1]

Location.—Intestine.

Locality.—Manila.[2]

Type specimen.—Philippine Bureau of Science parasitological collection No. 660 (deposited in the Bureau of Science for safekeeping).

Of the known members of the genus *Prosorhynchus* Odhner, 1905, this trematode most closely resembles *P. crucibulus* (Rudolphi, 1819), as described by Eckmann (1932). It may be distinguished from the latter by the following characters: the arrangement of the genital glands and the extent of the uterus and the vitelline glands. In *P. triangularis* the testes and ovary are arranged in triangular fashion around the pharynx; in *P. crucibulus* they are arranged in linear series on one side of the pharynx or the testes may be located behind the pharynx with the ovary on the medial side of the first testis. The uterus of *P. triangularis* is confined in the posterior region of the body behind the testes, while that of *P. crucibulus* reaches anteriorly to the anterior level of the intestine. In *P. triangularis* the vitellaria reach posteriorly to the posterior level of the second testis, while in *P. crucibulus* they extend only as far as the anterior level of that organ.

Family ALLOCREADIIDÆ Stossich, 1904

ORIENTOCREADIUM BATRACHOIDES Tubangui, 1931.

There are three specimens of this trematode, one from *Clarias batrachus,* the type host, and two from *Glossogobius giurus* which

[1] The scientific names of the fish hosts are according to the Check-list of Philippine Fishes by Roxas and Martin (1937).

[2] While some of the fish hosts might have been caught in Manila, the others might have been shipped to the city from towns around Lake Bay.

is here recorded for the first time as a host of the parasite. The specimens have been examined carefully in view of the question raised by Yamaguti (1934) regarding the presence of a vesicula seminalis interna. In two individuals the continuation of the external seminal vesicle within the cirrus sac is slightly dilated and filled with spermatozoa. The presence of this structure which is not visible in the type specimen justifies Yamaguti's opinion.

Hosts.—*Clarias batrachus* and *Glossogobius giurus.*

Location.—Intestine.

Locality.—Manila.

Family OPECOELIDÆ (Ozaki, 1925) Ozaki, 1928

OPEGASTER MINIMUS (Tubangui, 1928) comb. nov.

Synonym: *Opecoelus minimus* Tubangui, 1928.

We agree with Yamaguti (1934) that this fluke should be placed in the genus *Opegaster* Ozaki, 1928. The parasite appears to have a wide range of host tolerance, the collection containing numerous specimens obtained from five different kinds of fishes. Some of the specimens are exceptionally well preserved and show clearly certain structures which unfortunately were either overlooked or not interpreted correctly in the original description of the parasite. For example, the greater part of the vesicula seminalis is not enclosed within the cirrus pouch, but lies free in the parenchyma. The narrow portion of the vesicula seminalis externa near the base of the cirrus sac is surrounded by deeply staining cells. The cirrus pouch is small, pyriform to oval, 0.072 by 0.044 to 0.128 by 0.072 millimeter. A short Laurer's canal is present; it opens on the dorsal surface slightly to one side of the median line at a level in front of the ovary. The proximal portion of the uterus is filled with spermatozoa and probably functions as a receptaculum seminis. In a few specimens the acetabulum shows the presence of six marginal papillæ similar to those reported by Japanese writers in members of the genus *Opegaster.*

Some marked variations in the morphology of the fluke were also seen. The arrangement of the testes may differ so that instead of being tandem, as originally reported, they may be placed obliquely one behind the other. These organs are generally globular or oval, but in many individuals they are 2- to 3-lobed. In several specimens a single globular testis is present. Like the testes, the ovary sometimes show a lobed appearance.

Two specimens have the vesicula seminalis externa extending posteriorly far beyond the posterior border of the acetabulum and reaching almost to the ovary. Other specimens show the vitelline glands reaching far forward and sometimes meeting in the median line in front of the acetabulum.

Hosts.—*Glossogobius giurus, Ophicephalus striatus, Therapon argenteus, Clarias batrachus,* and *Arius manillensis.*

Location.—Intestine (one specimen is labelled as having been collected from the liver of *Glossogobius*).

Locality.—Manila.

Family AZYGIIDÆ Odhner, 1911

AZYGIA PRISTIPOMAI Tubangui, 1928.

One specimen in poor condition is found in the collection. According to Dickerman (1934), this trematode may be placed either in the genus *Azygia* or in the genus *Protometra* depending upon the arrangement of the principal excretory vessels. In the genus *Protometra* the lateral excretory vessels unite anterior to the oral sucker, while in the genus *Azygia* no such union of the vessels takes place. A restudy of the type specimen of the parasite has shown that the arrangement of the excretory system does not conform to that of the genus *Protometra.* The lateral excretory vessels do not unite, anterior to the oral sucker; on reaching the posterior or middle level of the oral sucker each vessel makes a sharp turn towards the posterior end of the body.

Host.—*Glossogobius giurus.*

Location.—Not stated.

Locality.—Manila.

Family HEMIURIDÆ Luehe, 1901

ECTENURUS LEMERIENSIS Tubangui and Masiluñgan, 1935.

This fluke is represented in the collection by one fairly well preserved specimen which is said to have been obtained from a goby. The type host of this parasite is the leather jacket, *Scomberoides* sp.

Host.—*Glossogobius giurus.*

Location.—Duodenum.

Locality.—Manila.

Family CLINOSTOMIDÆ Luehe, 1901

CLINOSTOMUM OPHICEPHALI sp. nov. Plate 2, fig. 2.

This is represented by one specimen obtained from *Ophicephalus striatus*. It constitutes the third species of clinostomid metacercariae to be reported from this fish, the other two being *Clinostomum dalagi* Tubangui, 1933 and *Euclinostomum multicaecum* Tubangui and Masiluñgan, 1935.

Description.—Body slipper-shaped, 2.8 millimeters in length by 1.1 millimeters in maximum width across acetabulum. Cuticle armed with numerous minute spines. Oral sucker ventroterminal, 0.27 millimeter across; acetabulum at junction of anterior and middle thirds of body length, 0.40 by 0.54 millimeter. Pharynx apparently absent; oesophagus 0.1 millimeter long; intestinal caeca wavy in outline, with short lateral branches, reach to near posterior end of body.

Testes near posterior end of body, small, tandem, appear as mere transverse lines bent in the middle; anterior testis 0.22, posterior testis 0.20 millimeter across. Cirrus pouch well developed, between ovary and shell gland, 0.17 by 0.065 millimeter, its bulk on right side of median line; incloses small seminal vesicle and short cirrus. Common genital pore median, in front of second testis, about 0.2 millimeter from posterior end of body.

Ovary small, intertesticular, on right side of median line, 0.11 by 0.06 millimeter. Shell gland and ootype complex on left side of median line opposite ovary. Uterine sac median, longitudinal, 0.8 millimeter long, extends from genital pore to about half the distance between acetabulum and anterior testis.

Excretory pore slightly dorsal, near posterior end of body. Excretory bladder small, V-shaped; lateral excretory vessels very prominent, lateral to intestinal caeca.

Host.—Ophicephalus striatus.

Location.—Gall bladder. (This is an unusual location for this type of trematode. Clinostomid metacercariae are ordinarily encysted in the muscles and beneath the skin of their hosts.)

Locality.—Manila.

Type specimen.—Philippine Bureau of Science parasitological collection No. 662.

This parasite differs from *Clinostomum dalagi* and *C. pseudoheterostomum* which were reported by Tubangui (1933) from

a fish and a frog, respectively, in its small size, the location of the genital glands near the posterior end of the body, and the shape of the testes.

Family HETEROPHYIDÆ Odhner, 1914

NEOCHASMUS MICROVATUS (Tubangui, 1928) comb. nov. Plate 1, figs. 2 and 3.

Synonyms: *Metadena microvata* Tubangui, 1928.
Metadena ovata Tubangui and Francisco, 1930.

There are three specimens of this trematode, one of which is in fair condition. It has been noted that the genus *Metadena* Linton, to which the parasite was originally assigned, is given an uncertain status by systematic writers in the scheme of classification of the trematodes due most probably to the scanty knowledge on the morphology of its members. For this reason it was decided to study carefully not only the specimens in the collection but also the type material. As a result, the following taxonomic features that were overlooked in the original description have been found: the presence of small spines around the mouth opening, a voluminous receptaculum seminis, and a genital sinus that is intimately associated with the acetabulum; the submerged position of the acetabulum; and the ventral position of the ovary. These characters together with those already given in the original description place the parasite in the heterophyid genus *Neochasmus* Van Cleave and Mueller, 1932.

The circumoral spines occur in a single row. They can be easily overlooked because of their minute size, the average length being 13.5 microns. They also appear to be easily detached, for of ten specimens examined only two show their presence. One of these two specimens has 7 and the other 16 spines.

The receptaculum seminis, which was mistaken for a part of the seminal vesicle, is voluminous and is dorsally located. In dorsal view, it is seen to occupy most of the space between the intestinal caeca and the testes.

The acetabulum is slightly retracted into the body. It is associated in heterophyid fashion with a small genital sinus, into which the terminal portions of the male and female reproductive organs open. A typical gonotyl cannot be made out, but posterior to the genital pore there is a cuticular thickening which may take the place of a gonotyl.

Host.—*Glossogobius giurus.*

Location.—Intestine.

Locality.—Manila.

Family MICROSCAPHIDIIDÆ Travassos, 1922

Synonym: ANGIODICTYIDÆ Looss, 1902

HEXANGIUM AFFINUM sp. nov. Plate 2, fig. 1.

This parasite, of which several specimens are available, belongs to a group of trematodes which has been classified by some authors with monostomes because of the presence of only one sucker. According to Odhner (1911), these flukes are really amphistomes in which the acetabulum has disappeared. Travassos (1934) has classified them accordingly and placed them in the family Microscaphidiidae.

Description.—Body elongated, 2.7 to 3.0 by 0.8 to 1.0 millimeters, anterior end usually more attenuated than posterior end. Cuticle armed with very fine spines. Oral sucker subterminal, well developed, 0.20 to 0.24 millimeter in diameter; prepharynx 0.40 to 0.46 millimeter long; pharynx poorly developed, 0.12 to 0.15 by 0.12 to 0.17 millimeter; oesophagus very short, practically absent; intestinal caeca large, slightly dilated at their blind ends, reach posteriorly to in front of testes.

Testes globular to oval, near posterior end of body, one usually slightly and obliquely behind the other; they measure 0.24 to 0.26 by 0.24 to 0.30 millimeter. Seminal vesicle a long sinuous canal, free in parenchyma, extends from in front of middle of body length to cirrus sac. The latter is circular in outline, poorly developed, 0.10 to 0.12 millimeter across. Other details of male reproductive system not discernible in available specimens. Common genital pore median to submedian, about midway between oral sucker and intestinal bifurcation.

Ovary median to submedian, immediately posttesticular, in contact with one of testes, globular to slightly oval, 0.10 to 0.12 by 0.10 to 0.16 millimeter, or about half the size of either testis. Shell gland small, behind and dorsal to ovary. Receptaculum seminis and Laurer's canal not discernible. Uterus moderately well developed, confined between intestinal caeca. Vitellaria in distinct, variously shaped follicles, arranged (in extended specimens) in four linear series, one series on each side of caecum; they extend from level of junction of anterior and middle thirds of length of caeca to in front of blind ends of caeca. Vitelline reservoir small, to one side of median line, in front of shell gland. Eggs oval, yellowish, operculated, 80 to 100 by 48 to 57 microns.

Excretory pore dorsal, near posterior end of body. Excretory bladder large, occupies most of space behind ovary; it presents posteriorly a heart-shaped, thick-walled cavity and anteriorly it gives off on each side a conspicuous excretory vessel, the course of which is not discernible.

Host.—*Amphacanthus javus.*

Location.—Intestine.

Locality.—Manila.

Type specimens.—Philippine Bureau of Science parasitological collection No. 661.

The host of *Hexangium affinum* is also known as *Siganus javus* and is therefore generically related to *Siganus fuscescens*, the host of *Hexangium sigani* Goto and Ozaki, 1929, the type and heretofore the only species of the genus *Hexangium*. The two parasites are also closely related, but they may be distinguished from each other by their size and the arrangement of their testes. *H. affinum* is smaller, 2.7 to 3.0 by 0.8 to 1.0 millimeters, and its testes are almost symmetrical. *H. sigani*, on the other hand, measures 8.0 to 10.3 by 1.8 to 2.2 millimeters and its testes are almost tandem or at least more centrally placed than those of *H. affinum*.

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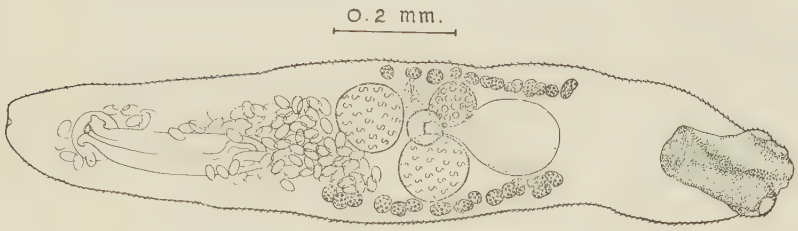
ILLUSTRATIONS

Plate 1

Fig. 1. *Prosorhynchus triangularis* sp. nov., entire worm, ventral view.
2. *Neochasmus microvatus* (Tubangui, 1928), entire worm, ventral view.
3. *Neochasmus microvatus* (Tubangui, 1928), entire worm, lateral view.

Plate 2

Fig. 1. *Hexangium affinum* sp. nov., entire worm, ventral view.
2. *Clinostomum ophicephali* sp. nov., entire worm, ventral view.



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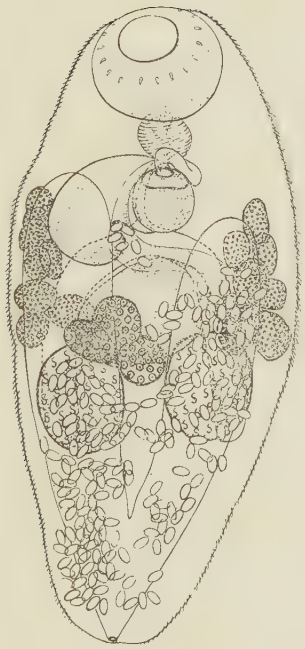

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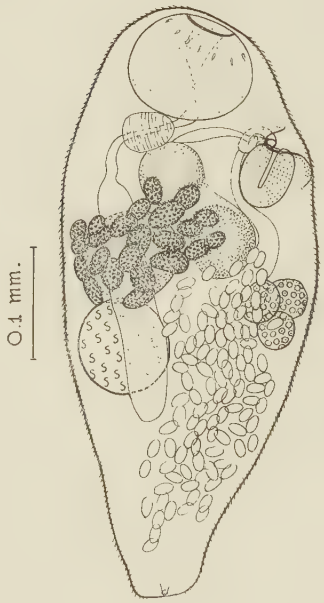

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PLATE 1.

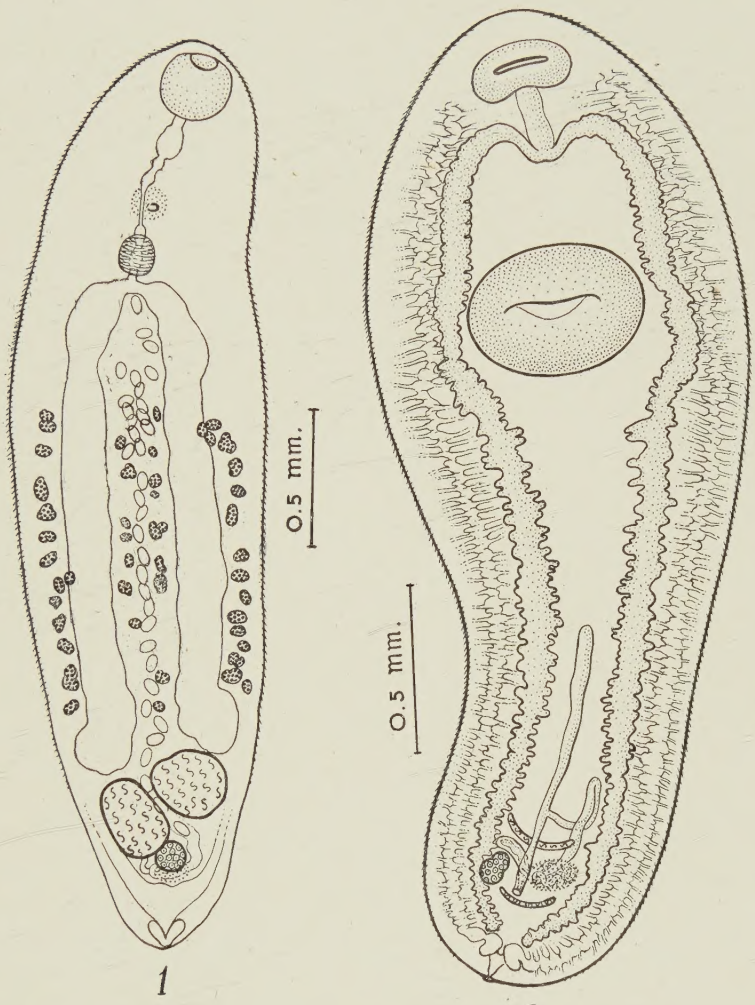

PLATE 2.

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